AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 7, No. 1. WEEKLY. | NEW YORK, JANUARY 5, 1884. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

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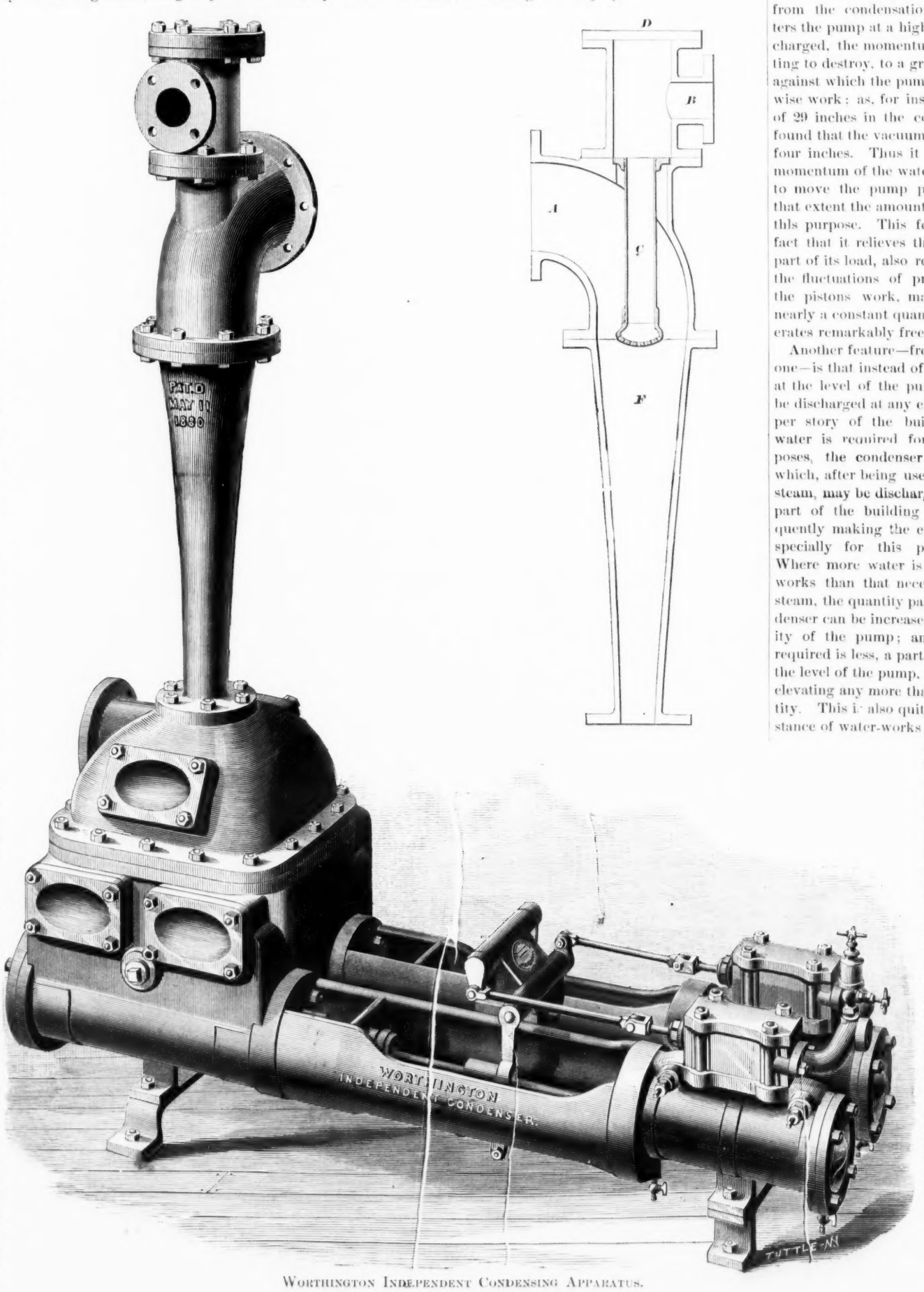
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

The Worthington Independent Condensing Apparatus.

Within the past few years the use of independent condensing apparatus for steam engines has become common. This has been brought about in part by the more general employment of high rotative speed, at which it is not practicable to run direct connected air pumps, and no doubt in part by the requirements of changing—for economic reasons—non-condensing to condensing engines, in which the conditions of construction and location are frequently such as to make, for lack of room, the attachment of an air-pump worked from the crank shaft, or from some other part of the engine, inconvenient, if not impracticable. In other instances the engine may be situated so that an air-pump worked from it will not be within lifting distance of the water. Whatever the circumstances may be in either of these respects, the independent apparatus will usually be found to remove the difficulties. In marine engineering the independent apparatus is also fast growing in favor, since under the conditions of stopping, starting, backing, etc., it will keep steadily along with tne vacuum always formed.

Various independent condensers have been devised, one of which, by the Worthington Hydraulic Works, 86 and 88 Liberty Street, and 145 Broadway, New York, possessing several novel features, is represented by the engraving on this page. It consists essentially of an adaptation of the well known duplex pump made at these works to serve as the air-pnmp, and a peculiar form of injector condenser.

The condenser *F* is shown in perspective aud in section. It is mounted top of the pump chamber, and the whole located wherever most convenient with reference to the engine, the only limit in this respect being that the pump shall not be further than about 25 feet above—that is within lifting distance of—the water. The injection-pipe is connected to the flange *B*, near the top of condenser, and the exhaust-pipe is connected to flange *A*. From the flanged joint immediately below the water connection a brass pipe, *C*, extends downward and into the condenser proper, through which the injection water must pass. This pipe terminates in a semi-spherical end, perforated with holes one-half inch diameter, forming a "rose," through which the water is discharged in a spray.



WORTHINGTON INDEPENDENT CONDENSING APPARATUS.

The steam passes down the ample annular space between the interior surface of the condenser casting and the exterior of the brass water-pipe, and at the rose termination of the latter is brought into intimate contact with the water and instantly condensed. The condensed water, and that resulting from the condensation of the steam, enters the pump at a high velocity, and is discharged, the momentum of the water operating to destroy, to a great extent, the vacuum against which the pump pistons would otherwise work; as, for instance, with a vacuum of 29 inches in the condenser it has been found that the vacuum in the pump was only four inches. Thus it will be seen that the momentum of the water is, in effect, utilized to move the pump pistons, decreasing to that extent the amount of steam required for this purpose. This feature, aside from the fact that it relieves the pump from a large part of its load, also reduces to a minimum the fluctuations of pressure against which the pistons work, making this pressure so nearly a constant quantity that the pump operates remarkably free from jars and strains.

Another feature—frequently an important one—is that instead of discharging the water at the level of the pump, it can, if desired be discharged at any elevation, as in the upper story of the building. Thus, when water is required for manufacturing purposes, the condenser will lift the water, which, after being used for condensing the steam, may be discharged into tanks in any part of the building for further use, frequently making the employment of a pump specially for this purpose unnecessary. Where more water is required around the works than that necessary to condense the steam, the quantity passed through the condenser can be increased up to the full capacity of the pump; and where the quantity required is less, a part can be discharged at the level of the pump, avoiding the work of elevating any more than the required quantity. This is also quite important in the instance of water-works engines, as instead of taking the water from the main suction-pipe and discharging it direct, so that it goes to waste, it may be returned again to the suction-pipe, or even into the discharge-pipe from the main engines.

As previously stated, the condenser is located wherever is most convenient, the piping being simple and no foundation required. In use the pump is started before the engine, and lifts the water to the condenser; then upon starting the engine the exhaust steam is condensed, forming the vacuum which relieves the pump of most of its duty of lifting the water. There is, for obvious reasons, no danger of the injection water being drawn into the cylinder of the

main engine, and hence no precautions against this are necessary.

Should the pump be stopped at any time it would simply result in the flow of injection-water ceasing, the vacuum would be destroyed, and the exhaust steam would escape through the pump-valves and injection-pipe.

The entire arrangement is simple and not liable to derangement. The holes in the rose are beveled from the outside, and so large that a coarse strainer on the water supply will stop anything that will not pass unobstructedly through them. Should the rose at any time require cleaning, by simply removing the cap *D*, at the top, the brass pipe can be lifted out and returned, no disconnecting of pipes or other parts being necessary. Under particularly unfavorable conditions, where a strainer cannot be used, a substitute for the rose is employed, which is still less liable to clog.

The pump-valves are come at by removing bonnets at the sides, and the valves as well as the pump rod stuffing-boxes are flooded with water to prevent leakage of air. The arrangement in use on other Worthington pumps for regulating the length of stroke to avoid dead space is employed in this. This condenser is used for vacuum pans as well as for steam engines.

How the Fastest Train in America is Run.

BY ANGUS SINCLAIR.

THE CHICAGO LIMITED EXPRESS.

Through the courtesy of Mr. Pettit, superintendent of the New York division of the Pennsylvania Railroad, I recently enjoyed the privilege of riding to and from Philadelphia on the engines pulling the Chicago limited express train. The following notes were suggested by the journey:

AVERAGE SPEED.

The New York and Chicago limited express train, run on the Pennsylvania system of railroads, passes over the distance of 912 miles between the two cities in twenty-five hours and twenty-nine minutes, making an average speed of 35.29 miles an hour. All the known resources of mechanical science have been ransacked to produce appliances for reducing delays, so that the highest possible percentage of the time provided for the journey should be devoted to running. Water for steam-making is collected as the train runs along from troughs placed in the middle of the track; a system of absolute block signals, controlled by vigilant train dispatches, provides a clear line; and stops are only made for the purpose of changing the locomotives at the ends of divisions. The lines over which the train runs traverse a multitude of cities and towns, most of them having the streets crossing the track on the level, and a great many other railroads are crossed at grade. Therefore, although the actual stops between Jersey City and Chicago are only seven, a run exceeding ten miles without meeting with the necessity of checking the speed is rare.

SPEED BETWEEN JERSEY CITY AND PHILADELPHIA.

The run of ninety miles from Jersey City to Philadelphia is made at an average speed of 45 miles an hour, leaving an average of 34 miles an hour for the remainder of the journey. To keep on time, some parts of the first division must be traversed at a speed over 60 miles an hour, while 50 miles an hour must be maintained over a considerable portion of the other divisions.

REQUISITES OF A HIGH-SPEED LOCOMOTIVE.

The first essential for a high-speed locomotive is the means of generating steam freely as fast as it is used up by the cylinders. The next consideration is properly-designed steam distribution gear and well-proportioned machinery, so that the heat energy produced by the boiler may be converted into useful work in propelling the engine with the least possible loss of power. To handle the fast trains between New York and Philadelphia, the mechanical talent of the Pennsylvania Railroad, aided by 50 years' inherited experience, has produced the form of engine known as Class K. This is an anthracite coal-burning locomotive, with 1,205 square feet of heating surface to supply steam to cylinders 18″x24″, which turn two pairs of coupled drivers 78 inches diameter. The traction force of the engine is thus $\frac{18^2 \times 24}{78} = 99.69$ pounds for each pound of effective pressure per square inch of the pistons. The valves are the plain slide, with 1¼ inch outside lap, on inside lap, $\frac{1}{16}$ inch lead in full gear, and a full travel of 5½ inches. The steam ports are 16¾ inches long and 1½ inches wide, while the exhaust port is 3¼ inches wide, securing free emission of steam.

MAKING UP THE FIRE.

Locomotives belonging to this company are not permitted to cool down, unless the fire has to be drawn that work may be done. At the end of a trip the fire is cleaned and banked to wait for the next run. By getting to the round house two hours before train time, we find our engine receiving the first work of preparation for the trip. The fire is spread over the grates, and a fresh supply of coal laid over the whole fire. To make an engine steam freely with anthracite coal, it is very important that the fire should be properly burned through before starting out. About two hours' time is needed for this, so that the mass of coal will get properly ignited without the aid of the blower. A fire that has to be forced along with the blower never proves satisfactory.

GETTING READY FOR THE TRIP.

The engineer and fireman reach the round-house about half an hour before train time, and each proceeds to do his own line of work preparing the engine for the run. The engineer attends to oiling round, an important matter where 90 miles have to be passed without stopping. Each bearing and rubbing surface is provided with an oil cup, with feed carefully regulated to supply the required lubrication. Mechanical ingenuity has arranged excellent methods for securing regular lubrication, but the care and skill of the engineer are needed to keep them working properly. As he moves round the engine his trained eye detects the smallest defect, and as he examines every cup and reservoir, the touch in time that prevents the delay is given wherever needed. At the same time the machinery gets a final inspection, and the air pump is started going. Meanwhile, the fireman has been attending to his duties—giving the fire its finishing touches, filling oil cans, and brushing the dust off the cab fittings.

Now we back up to the train. The air hose is coupled, two minutes' fast pumping of the air pump charges the car reservoirs with their full pressure of air, and we are ready for the start. While waiting for the signal I look into the fire-box, and see a furnace 10 feet long by 42 inches wide filled up with coal to a depth of 10 inches. It takes about a ton and a half of coal to make this fire ready for the road. The fire was level on the surface, but the greatest depth was in the front where the grates slope downward. The fire-box alone gives a heating surface of 120 square feet.

THE TRAIN TO BE PULLED.

The train consists of five Pullman sleeping cars and one dining car, the six cars weighing 200 tons. The engine and tender, in working order, weigh 74 tons, which give a total weight of 274 tons to be moved by the force exerted by the pistons.

THE START.

As the signal is given to start, the engineer drops the links full forward by means of the steam reverse gear, pulls the throttle lever open and the engine responds by moving forward. A sprinkling of sand is dropped upon the rails, the throttle valve is opened a little wider, and with resounding exhausts the engine is working into speed. From the start the necessity of pushing forward and utilizing every second of time is recognized. The train has not moved more than its own length when a speed of ten miles an hour is reached. The engineer now hooks back the links to cut off at ten inches, pulls the throttle wide open and lets her go. While waiting at the station, steam was kept down to 130 pounds by the injector and heater. The injector was shut off just before starting. When we got out about half a mile the steam-gauge began to point towards 140, the popping pressure, and the engineer started the injector, and it was kept going continually during the remainder of the trip. It is a No. 9 Sellers', and can supply the boiler during the heaviest work without reaching the limit of its capacity. There is a No. 8 injector on the fireman's side, but it is never used to run by. The injector and air-pump are two things about these engines that seldom need to be touched on the road after they are set to work.

GETTING THE TRAIN OVER THE ROAD.

The first two miles out of Jersey City a grade of about 40 feet is ascended, but the summit is reached in four minutes, then the links are hooked up to the 8-inch cut-off, which is the ordinary running point with this train. Next mile is passed in 85 seconds, but is finished by shutting off steam to let the engine roll over a bridge. Here the valves are oiled, a duty which is repeated three times during the trip. Although steam was shut off for only about 300 yards, the speed was perceptibly reduced, and it took a minute and a-half to make the next mile. Three miles succeeding that were traversed in 3½ minutes, one of them being run in 59 seconds, but again a demand for reduced speed intervened in the shape of the street-crossings of Newark—the city being approached by a sharp curve. Here the speed was reduced to 12 miles an hour, and two miles were run at a rate under 30 miles an hour. A spurt is again made, and the second mile, after getting clear of the street-crossings, is passed in 63 seconds, the next mile in 61 seconds, when another reduction of speed for Elizabeth streets and a railroad crossing takes place. After passing this town, a speed of one mile in 57 seconds was attained, several miles having been traversed in a minute each, then came the watering point, where the speed was reduced under 20 miles an hour. Thus it was through the whole trip. A struggle to get up speed, then comes the necessity for dissipating part of the power gained in raising the load to the required velocity. The engine maintained a speed of sixty miles an hour easily enough, but it was a laborious proceeding increasing the speed in a couple of miles from a mile in two minutes, to a mile in one minute. Several heavy grades were ascended, one of them three miles long, which reduced the speed in the second two miles to 30 miles an hour, although the links were dropped to 10 inches cut-off. The highest speed attained during the run was a mile in 55 seconds. The greatest speed was reached with the links hooked back to cut off at 7 inches. It is well understood by engineers running these trains, that high velocity can only be attained with the lever well notched back. Sixty miles an hour is nearly the maximum speed these engines will make cutting off at 8 inches, and the train is so heavy that the amount of steam represented by that cut-off is needed to maintain the speed on curves or slightly ascending grades. The fastest running is done under the favorable conditions of a straight, level track, or descending grade, where the engine can handle the train at 6 or 7 inches cut-off. When running over sixty miles an hour, if the lever be advanced a notch the speed will decrease, for more steam gets into the cylinders than can be exhausted at the high-piston velocity, and back pressure ensues, which acts as a brake upon the engine. Even with the big driving-wheels of this locomotive, the piston speed at 60 miles an hour is very high. In traversing a mile in one minute, the wheels make 258½ revolutions, giving a piston speed of 1034 feet.

HOW THE ENGINEER DID HIS WORK.

The engineer exhibited remarkable skill and intelligence in handling the engine. The water was carried steady without any fluctuation, which enabled the fireman to maintain the steam at an even pressure. Where the speed had to be reduced, no more braking was done than was absolutely necessary, and the brake was applied so gradually that it was hard to distinguish that the speed was not being reduced merely through natural loss of inertia. Every time the steam was shut off the links were dropped, giving the valves full travel. Many engineers do not recognize the urgent necessity for doing this. They will shut off steam and leave the engine running hooked up, a practice which proves destructive to valves, their seats, pistons, and cylinders. Take the case of the engine cutting off at six inches of the stroke. As the piston moves from the point of cut-off to the point of release, a partial vacuum is formed in the cylinder, and as soon as the valve opens the exhaust the hot cinder-laden gases from the smoke-box rush in through the nozzles to fill the void in the cylinder. During the return stroke, compression begins about eight inches before the completion of the stroke, and, as the compression is too great for the valve to hold down, it is jerked violently away from its seat, causing the clattering so well known where engines are running hooked up after the steam is shut off. I have known several cases of valves getting "cocked" from this cause alone.

HOW THE FIRING IS DONE.

The fireman's part of the work of getting the train over the road was no less skillfully done than that of the engineer. During the first seven miles of the trip he did nothing for the fire other than crack up some coal lumps. All the coal burned was broken down to pieces about the size of two bricks. When he seemed to think the proper time had come he glanced at the fire, then threw in one shovelful of coal. To pitch coal on to the right spot in a fire-box ten feet long requires considerable skill when the engine is swinging at a mile a minute speed, but this youth seemed equal to the task. He did not pile in a load of coal and then climb up into the cab to wait for it to burn, as is the practice of the poor fireman. After he began to fire he kept at it. About every two minutes he got in a shovelful of coal. When the engine was working hard getting into speed he varied his intervals of firing; but he worked on a system, which was to keep up the body of fire and maintain the temperature as nearly even as possible. He followed scientific methods, whether he understood anything about science or not. He never hesitated about the spot where the coal was going, but pitched it in and closed the door quickly, waiting till the turn for the next installment came round. By this means the steam never felt the chilling effect that results from heavy charge firing. The steam-gauge index kept pointing at 135 as steadily as if it had been fastened there. About eight miles from Philadelphia the fireman stopped putting in coal, and in the remainder of the run he several times used the hoe to level the fire.

When we stopped at the station, about four inches of glowing cinders covered the grates.

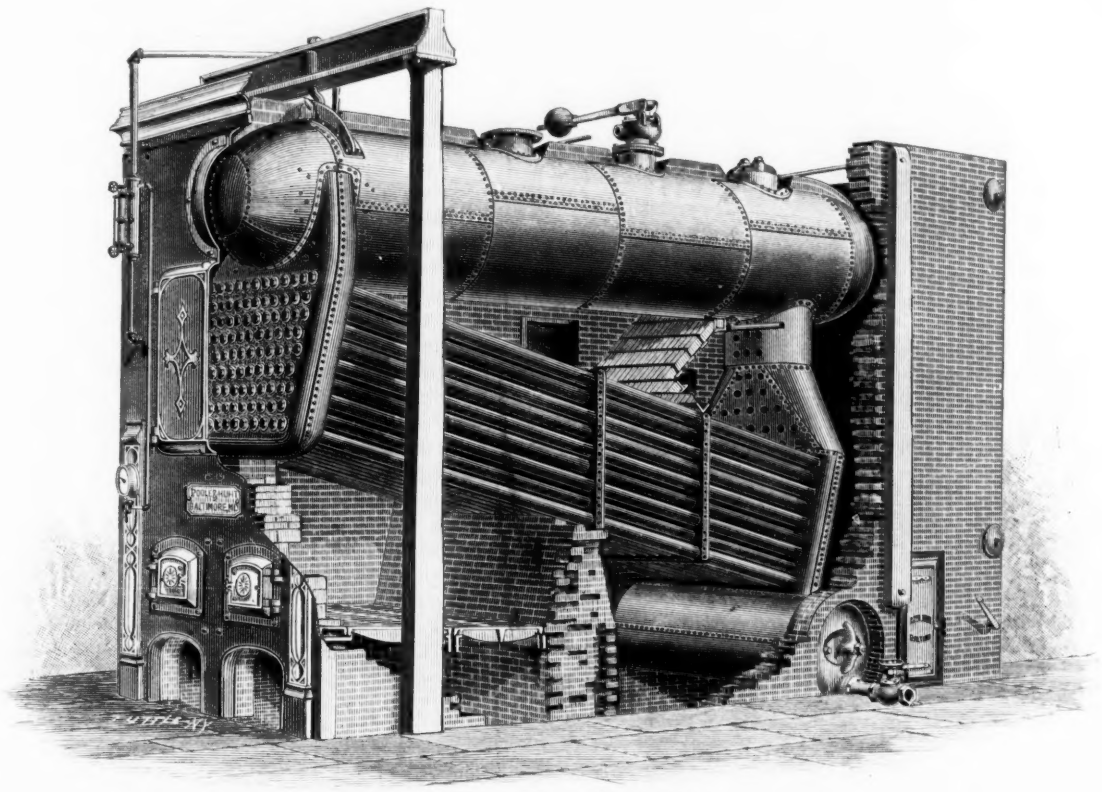
RETURN TRIP.

On the return trip another engine of the same class brought the train through. The train reached Philadelphia late, and the run to Jersey City was made in 108 minutes, an average speed of 50 miles an hour. Some remarkably fast running was done on this trip, one mile having been run in fifty-one seconds.

It was dark when the train started, which gave a good opportunity to watch the operation of the block system, which enables trains to be moved at this high speed with safety, and gives the runners confidence in finding a clear trackway. From block to block the signals went from red to white as we approached, indicating that our way was clear. As the train comes rushing along through the darkness, electricity enables the train dispatcher in his office at Jersey City to follow its progress, and move every obstacle that might cause delay. The men who worked the engine did their part as perfectly as skill and intelligence could dictate. The American locomotive engineer has no equal in ability and intelligence, and the Pennsylvania Railroad engineer is second to none in the country.

The Poole & Hunt Water-tube Boiler and Plain Slide Valve Engine.

The boiler shown herewith is composed of lap-welded wrought iron tubes, placed in an inclined position and connected by vertical passages at each end, with a horizontal steam and water drum. The tubes are "staggered," or so placed that one row comes over the spaces of the previous row. The vertical passages, or end connections, are made of two plates of the best flange iron or steel, placed far enough apart to give full area for the circulation between the inclined tubes and horizontal drum. The plates are flanged at sides and bottom, and strongly stay-bolted together. The tubes are expanded into the inner plate, and suitable hand-holes in the outer plate admit the tubes and allow for cleaning. The connection to the drum is durably made in the strongest manner, and subjected to a hydrostatic pressure of 300 pounds. The fire is made under the higher end of the tubes, and the products of combustion pass up between the tubes into a combustion chamber under the steam and water drum: from thence they pass down across the tubes, then once more up through the spaces between the tubes, and off to the chimney. The water being inside the tubes, as it is heated, tends to rise toward the higher end, and, as it is converted into steam—the mingled column of steam and water, being of less specific gravity than the solid water at the back end of the boiler,—rises through the front end connection into the drum above the tubes, where the steam separates from the water, and the latter flows back to the rear and down again through the tubes in a continuous circulation. As the end connections are large (the full area of the tubes being maintained), this circulation is very rapid, for which three important advantages are claimed:



POOLE & HUNT WATER TUBE BOILER.

1st. It sweeps away each particle of steam as fast as formed, and supplies its place with a particle of water, thereby absorbing the heat of the fire to the best advantage, and thoroughly separating from the water in the large disengaging surface in the steam and water drum, preventing what is known as "priming," or "foaming," the steam passing away from the boiler dry even when the boiler is forced to its utmost capacity.

2d. It causes a thorough commingling of the water throughout the boiler, and a consequent equable temperature, thus preventing strains from unequal expansion, which are a frequent cause of explosions.

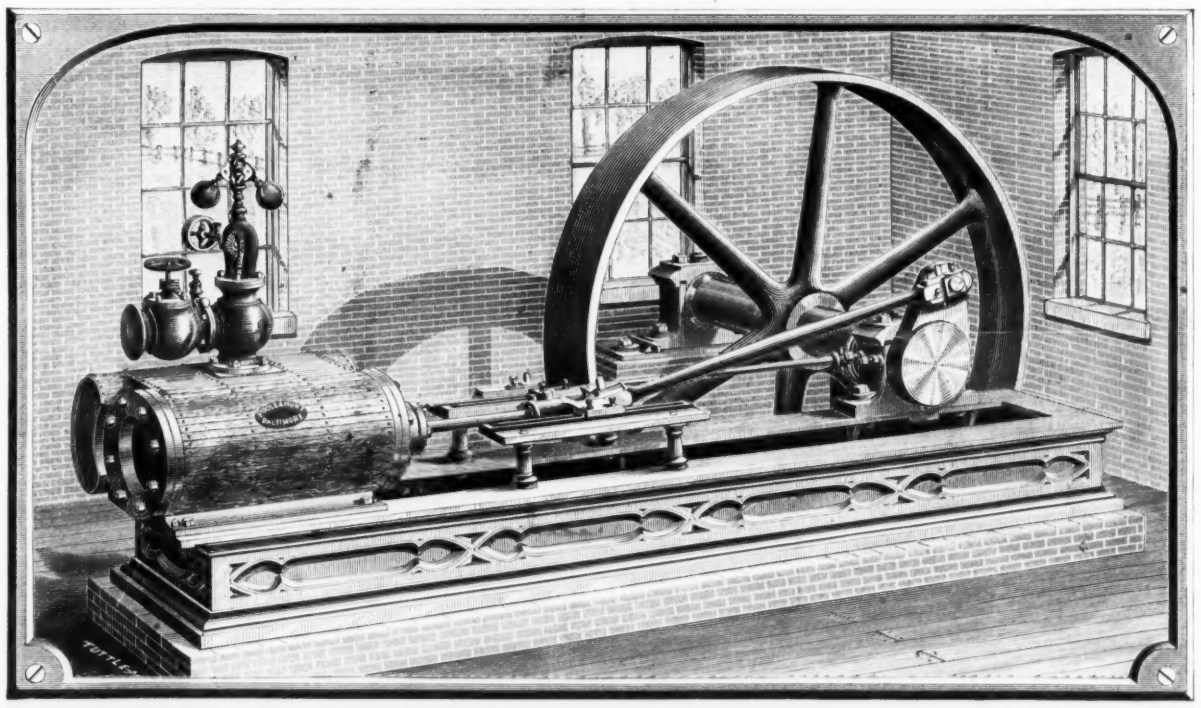
3d. The rapid circulation prevents, to a great degree, the formation of deposits or incrustations upon the heating surfaces, sweeping them away and depositing them in the mud drum at the rear and lowest point of the boiler, whence they are blown out.

A hand-hole at the end of each tube permits access thereto for cleaning, should they become scaled by the use of very bad water; and manholes in the steam and mud drums admit access to them for the same purpose. Should it be necessary, for any cause, a tube may be readily removed and another substituted. The front end of boiler is suspended from a girder, supported by columns entirely independent of the brickwork; and all the mountings, including gauges, safety valve, &c., are of approved patterns.

It is now quite generally conceded, and borne out by the experience of boiler insurance associations in this country and England, that the mysteries of boiler explosions consist in a want of sufficient strength. This lack of strength may be inherent in the original construction, or it may be the effect of weakening the iron by unequal expansion, caused by unequal heating of different parts; or it may be due to corrosion from long use or improper setting.

This boiler, being composed of wrought iron tubes, with drums and connections made of the best wrought iron or steel plates, has a great excess of strength over any pressure which it is desirable to use; and, as the rapid circulation of the water insures equable temperature in all parts, the strains due to unequal expansion can hardly occur to deteriorate its strength. Should one of the tubes give out, which does not seem probable, no explosion could occur; and in case the water be allowed to get so low as to overheat the shell and cause it to give out, what water remained would be confined to the tubes, and could not cause a destructive explosion. Several thousand horse-power of these boilers are already in use, and are said to have given the best of satisfaction, being considered entirely safe at high pressures of steam. They are manufactured by Poole & Hunt, Baltimore, Md.

The steam engine illustrated is manufactured by the same firm, and is a simple slide valve engine, well constructed and arranged, and clearly represented by the engraving.



POOLE & HUNT SLIDE VALVE ENGINE.

The Allen Slide Valve.

About twenty years ago, John F. Allen, of New York, perceiving the defects of the ordinary slide valve for purposes of high speed, invented an improvement in the shape of a supplementary passage over the exhaust cavity, which practically gave a double opening when the valve was cutting off short. The advantage of the improvement was at once acknowledged by most of European engineers, and the Allen valve became an accepted feature of all high speed locomotives. There was, however, no honor for this inventor in his own country, for American master mechanics steadily refused to patronize the Allen valve. Of late years it has been making gradual headway into favor among our master mechanics, and the New York, West Shore & Buffalo Railway Company have adopted it as standard for their passenger engines. There is now no patent on the valve, and any railroad company is free to use it. Those running engines with high piston speed stand in their own light by not trying this valve. Its utility and economy have been demonstrated where the means resorted to for telling the value of a device were accurate experiments performed by mechanical experts.

On one of the leading railroads in this country an engineer was running a locomotive on a fast train where it was a hard matter making the card time. A few minutes could be saved by passing a water station, but this was done at serious risk, for the tender would nearly always be empty by the time the next water station was reached. The master mechanic of the road determined to equip this engine with the Allen valve, and after the change was made there was no risk in passing the water station, for there always was a good margin of water in the tank when the next watering place was reached. The engine seemed to steam better, because the work was done with less steam, and there was a decided saving of fuel. The change made the engine smarter, and there seems to be no limit to the speed she can make. This valve can be applied to any locomotive with trifling expense. When an engine is designed specially for the Allen valve, the steam ports and bridges are usually made a little wider than for the ordinary valve. The only real difficulty in adopting the valve is getting the casting properly made, so that the supplementary port will not be too rough for the passage of steam, and the thin shell will be strong enough to stand the pressure.

New Annealing Process for Cast Iron.

Word comes from Australia that a new method of annealing chilled cast iron has been discovered, which will produce important effects upon iron industries generally. The alleged discovery was accidentally made. A fragment of chilled cast iron was thrown into some water in a Melbourne foundry, and when picked up and broken it was found to be soft and tenacious instead of brittle, as would usually be the case. This led to inquiry, and many experiments were made to ascertain how the change had been produced.

The theory worked on was, that the temperature of the iron and some foreign element in the water combined to work a transformation on the metal, and numerous trials proved this to be correct. The exact conditions necessary for bringing about the change were discovered and iron that would only stand 1,200 pounds transverse strain was improved by the process to stand 1,900 pounds. The metal was dipped in a bath of ingredients which are cheap. The change wrought on the iron is physical, the molecules arranging themselves in an order which is conducive to strength. The experiments were conducted by members of the Melbourne university, and the authority of that institution is given for their correctness.

Slate's New Plain Milling Machine.

We present with this a perspective view of this machine: also a detached cut showing the construction of the clamp slide. It will be seen that there is no overhanging extension for supporting the outer end of cutter arbor, but that instead the support is connected directly to the bed of the table, the supported end being free to move endwise, thus providing for contraction and expansion, as well as furnishing a rigid support.

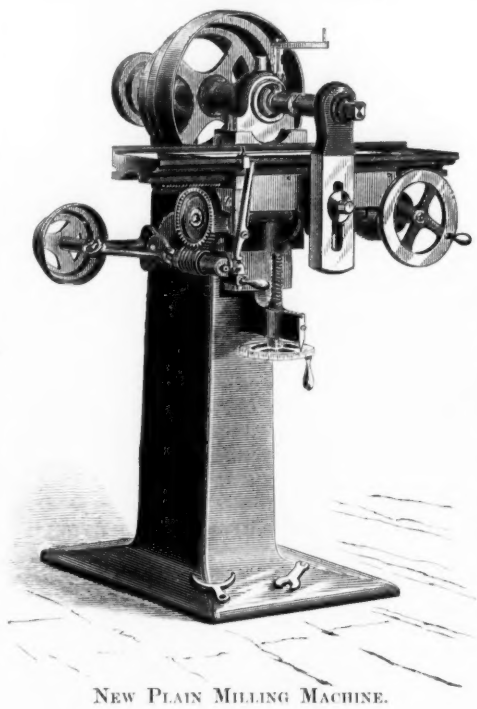
The spindle is adjustable, endwise, by means of collar nuts, so that the work may be located by the eye, and the cutter readily brought to the exact position required. There is no key-way through the spindle, the arbor being driven by a flattened collar, which fits in a corresponding recess in the spindle collar. For forcing the arbor out a steel rod, threaded at back end, squared for a wrench, passes through the spindle. By screwing this rod in, the end is brought against the end of the arbor, driving it out.

The vertical adjustment is four inches, and is made by means of a hand-wheel, and read to thousandths of an inch. The detached view shows the manner of clamping the slide. Since this slide is not subject to wear, to any extent, no gibs are required, but it is necessary to clamp this slide firmly, which is done by means of bolts, as shown in the detail engraving. The slide is slotted to permit travel to the full extent, and tightening the bolts binds it firmly.

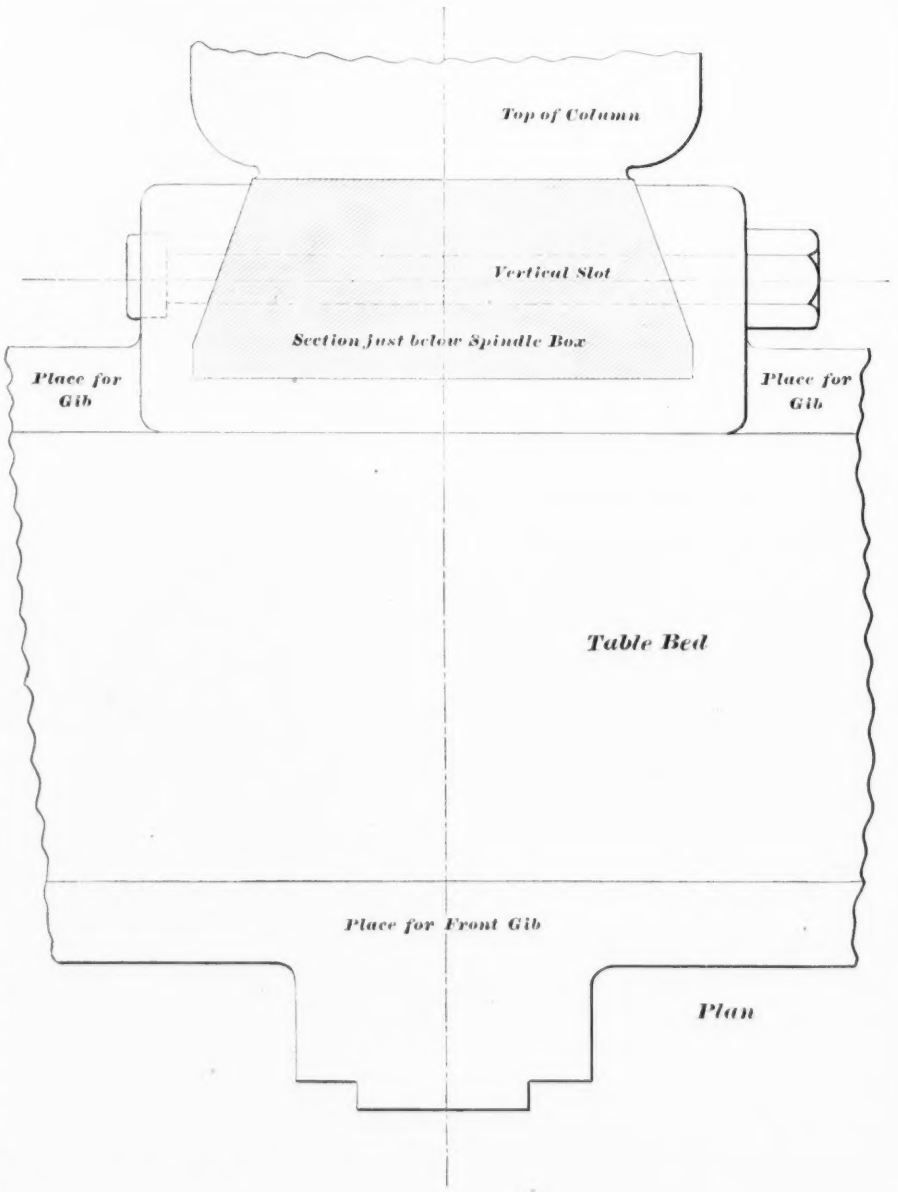
The movement of the table is ordinarily up to 15″, but when required, as for splining shafts, this distance can be made longer.

The cone pulley is three-graded, the largest diameter being 14″. The column is hollow, and fitted for a tool closet. The spindle, shafts, screws, etc., are steel, and boxes of phosphor bronze, with provision for taking up wear.

This machine is made by Dwight Slate, 262 Main Street, Hartford, Conn.



NEW PLAIN MILLING MACHINE.



Work in Baldwin Shops.

The Baldwin Locomotive Works have five compound motors for tramways nearly completed. They are built for the government of South Australia, and are made on the same design as the motor described in the AMERICAN MACHINIST of August 25th, 1883. Another small motor, about eight tons weight of the ordinary locomotive pattern is nearly completed for an Australian tramway company. There are several heavy ten-wheel locomotives in the erecting shop for South America. These engines have fire-boxes made of heavy copper sheet. At the sides of the fire-box there are hand holes about 2½″ diameter through the outen shell to be used for washing the crown sheet. The engines have extended smoke-boxes and are in other respects the standard ten-wheel engine of the makers. Work is very brisk in the shop.

Engineering gives illustrations and description of electric light plant fitted upon a splendid new steamship built in Glasgow for a firm in Australia. To the ship-builders was left the arrangement of lighting up the vessel properly. They selected the Edison lighting plant as best adapted for their purpose. The dynamo that generates the electricity is driven by a high-speed Westinghouse engine to which it is directly connected, the engine being adjusted to make 525 revolutions a minute. This engine is making its way into favor in Europe as a high speed motor.

The Burden Iron Works, Troy, N. Y., have reduced the wages of their employes about 10 per cent. Instead of ordering the reduction by posting printed notices around the mills and furnaces, they called a meeting of the workmen, gave the reasons why a reduction was desirable, and promised steady work for the men throughout the winter at the proposed low rate. The men were asked what they were willing to do, and with one accord they accepted the reduction without delay.

Leaky Foundation Rings.

A few years ago in their desire to obtain a few inches wider fire-box, some designer of anthracite burning locomotives placed the fire-box with the foundation ring on top of the engine frames. This was accepted as a radical improvement and was immediately followed by many master mechanics. It proved a good method of getting a wide fire-box, but some years' service with the engines begins to reveal serious disadvantages. As the ring is almost close to the frame there is no room to insert a caulking tool, and when the ring gets leaky either the frames have to be taken down or the boiler raised up before the caulking can be done. There are locomotives in this neighborhood running with the foundation ring leaking so badly that the steaming capacity of the engine is seriously degraded. As the expense of taking the engine apart to do the work is very great, it is permitted to run so long as water can be kept in the boiler with two injectors. Were the expense of coal wasted in this way figured up it would show a serious item.

The Boiler Shop.

BY GEORGE MARSHALL.

A great deal of time and attention has been given to the perfecting of the steam engine, and the number of patents granted to inventors of improved engines, governors, cut-offs, valves and valve gear, bear evidence to the fact that the steam engine of to-day has occupied the thoughts and dreams of many individuals, who recognized in it the almost Archimedean lever necessary to move the world. In no other branch of the mechanical arts has there been so many so-called improvements, and yet the steam engine of to-day, perfected as it is, is in reality but an unimportant factor in the general economy and uses of steam.

Your engine may be the very best; you may have the most complete and perfect machinery necessary for the manufacture of silks, woolens, wagons, carriages, and goods of every description; yet, when you wish to apply the power which drives the whole mass, you must go to the often-neglected and often-despised boiler room.

In many cases, the steam-user will apply thousands of dollars to the purchase of a first-class improved automatic cut-off engine. He carefully studies up the experience of others in the same line of business, and carefully listens to arguments in behalf of this or that engine from interested builders, then having made up his mind as to which is the best, the order is given, money paid, the engine arrives, is set in position, connected, and no thought given to the fact that after all the expenditure of time and money, the engine in itself is of no use without the steam generator or boiler, and the boiler is really the least thought of, although in reality the most important factor in the make-up of a first-class concern where steam is to be used.

In the boiler shop (whence this article is headed, and where this article originated), the individual making a tour of inspection of mechanical subjects is apt to turn away with disgust, or else make his stay as brief as possible; the incessant din of the hammers, as the wielders drive and form the rivets, and the caulkers give steady, uniform blows on the tool with which to make the boiler hydrostatically, or steam, tight, ordinarily play such sad havoc with the auditory nerves as to hasten the departure of almost every one, except those who, by years of experience, have become accustomed to the sound, and to whom the noise is almost as indispensable as their daily bread. In addition to this, the smoke arising from the forges, and the generally dilapidated appearance of boiler shops in general, as well as the dirt and iron on the floor, make a visit very unpleasant, especially when brought in contrast with the machine shop, where everything is bright and clean, and where the visitor can move around among the workmen and machinery, and see each machine performing its duties almost silently and automatically. Notwithstanding the noise, dirt and smoke of the boiler shop, it is here the greatest attention should be given, and here, I am sorry to say, the greatest ignorance prevails, and here, seemingly, the least education is required.

The iron used in a steam boiler is generally ordered from the mill in the exact shape and size required for the purpose in view; and while it may be never so perfect on leaving the mill, by improper manipulation from an ignorant, careless mechanic (mechanic often only in name) it may become highly dangerous when allowed to enter into the construction of the boiler. Too often, the defects arising from ignorance, lack of skill or improper manipulation, are hidden from the eye and knowledge of the foreman, and too often, alas, too often, the foreman, in order to make his shop as profitable as possible, glosses over a glaring defect, with the simple remark "'twill not be seen,"—regardless of the fact that life and limb are in great danger from the defect which to him appeared trifling and unworthy of thought. Sometimes even the proprietors of works are found who will censure the foreman for such work, yet will not hesitate to advise that it be made as good as possible, and rid themselves of the responsibility in this manner.

Care should be exercised in the flanging of sheets, that an unequal strain in any one place may not be caused by shrinkage. This is particularly the case where steel is employed for steam boilers, as the use of this comparatively new material is not as yet fully understood by the ordinary workman. In riveting, the excessive use of a drift is another source of danger, as in many cases, and under peculiar circumstances, a drifted plate, while evidently uninjured to the casual observer, will show great weakness and dangerous cracks either in the test or after short use.

Bracing is also a very important point in a boiler, and not always are the greatest number of braces evidences of the greatest strength.

This is particularly so where jaws are used, as the workmen do not always understand the necessity of having an equal strain on each brace; in fact, it is a considerable task to equalize the strain on such braces, as the contraction is unequal in cooling, and for other causes.

Caulking is also a very important matter. The common caulking tool in the hands of an ignorant unskilled workman is an actual

danger, while in the hands of a skilled workman there is nothing to be feared.

Various efforts have been made in punching of holes to overcome the loss occasioned by the crystallizing of the plate in the vicinity of the punched hole, and partial success has been attained in that direction. Still, much remains to be done, and patient study and research on the part of inventors will yet result in removing many of the dangerous methods now pursued in the manufacture of boilers.

I trust that this paper may be the means of inducing a more earnest attention to the study of one of the most important pieces of mechanism required and extensively used at the present time.

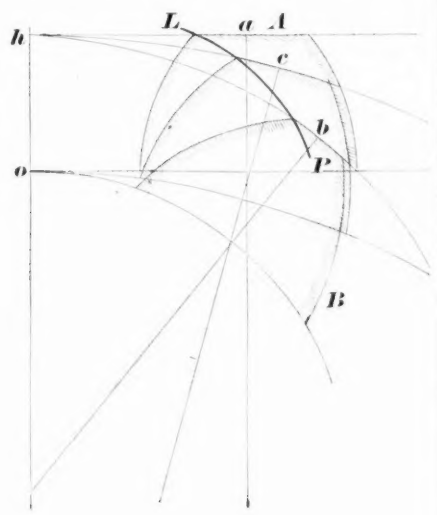
The Equidistant Series of Gear Cutters.

BY GEO. B. GRANT, BOSTON.

In an article in the AMERICAN MACHINIST, some time ago, I gave a rule by which this important series might be computed for any possible system, limits, or number of cutters, it having previously been computed by some unrecorded graphic or experimental method.

In a recently published and most valuable work on Kinematics, Prof. C. W. MacCord gives an extended discussion of the subject, and proposes a new method. As he criticises my formula in plain language, I shall take the same liberty with his method, and shall attempt to show just why I think he has made no improvement.

The figure shows at *A* the shape and position of the upper half of an epicycloidal rack tooth, and at *B* a tooth of the smallest pinion of the interchangeable set. The problem before us is to arrange the positions of a given number of intermediate teeth so that the steps from each one to the next shall be equal.



My method assumes that the length of the addendum arcs, *ha*, *hc*, *hb*, etc., should form an equidistant series, and from this assumption we obtain the formula

$$t = \frac{an}{n - s + \frac{a\,s}{z}}$$

in which a is the number of teeth in the smallest gear, usually 12; z the number of teeth in the largest gear, usually ∞ for a rack; n the number of cutters in the set, and s the number in the series of the cutter, which cuts up as far as t teeth.

From this formula, by a simple calculation, we can construct the Table III., and it takes but a few minutes and a few figures to fit any other case.

Prof. MacCord's method assumes that the length of the transcendental curve, *L*, *P*—the locus of the intersection of the epicycloidal face and the addendum circle—should be uniformly divided; and from this *assumption*, by a most laborious process which can be comprehended and applied only by an expert mathematician, he deduces the series IV.

My process and the professor's process both depend upon assumptions, and which assumption is the most correct appears to me to be a matter of opinion. Why his method is a "perfect solution of the problem," or what a perfect solution may be, he does not explain at any length.

The most perfect method possible would be to determine the maximum variation or error from a uniform velocity ratio, caused by a cutter when used at a given distance from its proper position in the series, and to so arrange the series that the maximum variation will be the same for all the cutters. The objective point of most of the work that has been put into the subject of toothed gearing is to obtain a uniform velocity ratio, and the method best adapted to preserve this uniformity is the most perfect method.

This would make an interesting exercise for a mathematician, but the result would be so close to the series now in use that it would be of no possible importance to any one else.

If we cannot follow the true method, but must assume an easier one, and make a short cut to reach our object, it appears to me that the shortest and easiest cut is the best one.

But then, as neither method is perfect, we will not quarrel as to which one is nearest to perfection. *If* the professor's method is the best, we can determine just *how much better* it is—how great an *improvement* has been made.

The professor has certainly delivered a most ridiculous little mouse from a mountain of learned research; for, when the two series are placed side by side, as at III. and IV., it is seen that they are practically identical.

III. GRANT.	IV. MACCORD.
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24–26	24–26
27–29	27–29
30–32	30–32
33–36	33–36
37–41	37–41
42–48	42–48
49–58	49–58
59–72	59–73
73–96	74–97
97–144	98–147
145–288	148–296
289–∞	297–∞

In fact, all except the last five terms are the same, and there the variation is of no measurable consequence.

For example, my formula places a point of division at 288 teeth, while the locus method places it at 296 teeth. The actual distance along the chord of the locus curve, *L P* from the point 288 to the point 296, is just one-third of a thousandth of an inch on a gear of four diametral pitch, which is a heavy gear for machine cut work.

That is, *if* the professor's method is an improvement upon my own, the *amount* of the improvement is almost unmeasurable, and certainly cannot be worked to in the manufacture of gear cutters.

I agree that "there is no excuse for resting contented with approximations, close or otherwise;" but I put it as a matter of common sense that a simple and easily-applied approximation is preferable to another approximation of bewildering complexity, particularly when the real difference between the two is an imperceptible fraction.

I feel obliged to dispute with Prof. MacCord upon this point, but I take the opportunity to express my appreciation of the services he has rendered in many other branches of the subject. His "Kinematics" is the most comprehensive and valuable work in this line since the "Principles of Mechanism" of Willis.

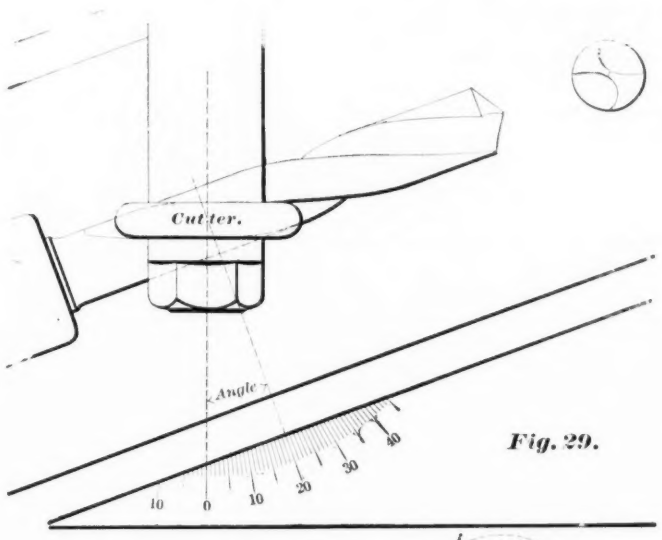


Fig. 29.

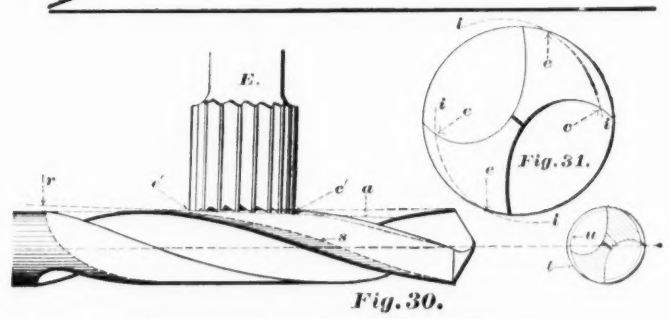


Fig. 31.

Fig. 30.

GROOVING AND CLEARING TWIST DRILLS.

While upon this subject, I will correct an error in the method I have given for finding the location of each cutter in its own interval, for the given rule that the number of intervals should be doubled and the intermediate values taken will make bad work on the first few intervals.

The proper method is to consider each interval as a series of two short intervals, and to assume the intermediate value as the proper location for the cutter. This assumption gives the formula:

$$v = \frac{2\,c\,d}{c + d}$$

in which v is the location of the cutter between any two limits, c and d.

For an example, take the interval from 27 to 29 teeth. The proper location of the cutter is:

$$v = \frac{2 \times 27 \times 29}{27 + 29} = 27.9$$

instead of 27.4, as found by the other rule.

Grooving and Clearing Twist Drills.

The following extract is, by permission, from the "Construction and Use of the Universal Milling Machine," a work published by the Brown & Sharpe Mfg. Co.:

The operation of cutting spiral flutes and forming a twist drill is shown in Fig. 29. The drill is held in a collet or chuck, and, if very long, is allowed to pass through the spindle of the spiral head. The cutter is placed on the arbor so that it will be directly over the center of the drill, and the bed is set at the angle of spiral. * * * * The depth of groove in twist drill diminishes as it approaches the shank, in order to obtain increased strength at the place where the drill is otherwise generally broken. The variation in depth is conditional; depending mainly on the strength it is desirable to obtain, or the usage the drill is subject to, as in different classes of work. To secure variation in the depth of the groove, the spiral head spindle is elevated slightly; depending, in this case, on the length of flute, for which, when 2 inches or less in length, the angle may be ½ degree; 2 to 5 inches, ¾ degree; 5 inches and over, 1 degree. This is generally satisfactory in this respect, in our own work, as the drills are seldom very long.

When large drills are held by the centers, the head should be depressed in order to diminish the depth of groove

The outer end of the drill is supported by the center rest, and, when quite small, should be pressed down firmly until the cutter has passed over the end.

Another, and very important operation on the twist drill, is that of "backing off" the rear of the lip, so as to give it the necessary clearance, to prevent excessive frictional resistance. In the illustration, Fig. 30, the bed is turned about ½ degree as for cutting a right hand spiral, but as the angle depends on several conditions, it will be necessary to determine what the effect will be under different circumstances. A slight study of the figure will be sufficient for this, by assuming the effect of different angles, mills and the pitches of spirals. The object of placing the bed at an angle is to cause the mill *E* to cut into the lip at *c* and have it just touch the surface at *e*. The line *r* being parallel with the face of the mill, the angular deviation of the bed is clearly shown at *a*, in comparison with the side of the drill. * * * From a little consideration it will be seen that, while the drill has a positive traversing and rotative movement, the edge of the mill at *c'* must always touch the lip a given distance from the front edge, this being the vanishing point, if such we may call it. The other surface forming the real diameter of the drill, is beyond reach of the cutter, and is so left to guide and steady it while in use. Fig. 31 is an enlarged section, showing the point *e*, where the cutting commences, and its increase until it reaches a maximum depth at *c*, where it may be increased or diminished, according to the angle employed in the operation, the line of cutter action being represented by *i i*. Before backing off, the surface of the smaller drills, in particular, should be oxydized by heating until it assumes some distinct color. The object of this is to clearly show the action of the mill on the lip of the drill, for, when satisfactory, a uniform streak of oxydized surface, from the front edge of the lip back, is left untouched by the mill, as represented in the cut at *e*.

Notes on Repairing Boilers.

BY W. H. H.

* * * * * * * *

If you have a fire-box or locomotive boiler it sometimes happens that a stay bolt breaks. This should be attended to at once, and a very convenient way is to put a common bolt in its place, with the head next to the fire, fitting it carefully in place, with a square washer about 2½ or 3 inches each way; and edges lipped to hold cement at each end of the bolt. If the iron is so thin that it yields and will not allow tightening, a piece of pipe may be cut square on its ends, to a length about equal to the distance between the sheets, or a trifle less. This thimble is strung into place by passing a cord directly through the holes from the inside to the outside of the fire-box; then an attendant hooks the bight of the string up inside the boiler, or out through some convenient manhole, cuts the string in two, passes one end through the thimble, and knots his string together again. Then, by a little management, the thimble may be hauled into its place and the bolt inserted.

* * * * * * * *

Boilers should be tested by hydrostatic pressure at least 25 per cent. greater than the working steam pressure. This you can do without need of a pump by filling your boiler solid full of cold water, and putting extra weights on the safety-valve and closing all openings. Then make up a wood fire in the flue under the back end, and another on the grates. The water expands by the heat faster than the boiler, and long before the temperature for making steam is attained

you will see the gauge running up. When it gets as high as you wish, give vent by opening the water-gauge cocks or safety-valve, and the pressure will fall. If leaks begin to show along the seams, you have reached the limit, and your proposed steam pressure must be reduced. There is no danger from such a test as this, as the pressure is produced by solid water and not by elastic hot steam, and as soon as any serious leak shows itself it relieves the pressure, and you cannot get more.

* * * * * * *

You come at last to closing up your boiler. The manhole, or hand hole plates, require new gaskets or packing rings, as boiler-making has not yet arrived at that state of refinement which requires a turned head with a ground joint to make it tight. What you have to do, then, is to make a packing which will enable two surfaces of cast iron, having projections of a quarter of an inch or so, to come together and hold the steam in your boiler. You remember that you ordered some gum rings when you were in town, 11″x16″, and you get them out and find that you have them, sure enough, but that they are not the same shape as your plates. One of the perplexing things about owning boilers is that no two men make their manholes of the same size or shape. This difficulty would seem to justify the appointment of a National Commission, under the cognizance of the metric bureau. You remember an old sea-going engineer, who told you that he always used a five-strand hemp gasket, well filled with red lead putty; but you will not know how to lay up a five-strand gasket until you can get instructions from a Dutch girl in the neighborhood, who plaits her back hair in a prodigious yellow tail. You have not the time to make the acquaintance of this young woman, so you cut your gaskets out of a thin board, soaking them well before you put them in place. You might have cut them from canvas, if you had canvas, or from sheet gum, but that is wasteful; or you might have cast lead rings, which, in many localities, are used; or even use small lead pipe, taking care that the ends join neatly. The pine-board racket you find does not do so well as you anticipated; so you make some rings of $\frac{5}{8}$″ round iron, fitting them to your plates as if they were to be used as gaskets. You now have some patterns, which you may use to mould from in sand, and pour them with lead, which makes first-class gaskets, particularly for high pressure steam.

* * * * * * *

A hard patch is a permanent job, which can only be done by a practical boiler makers. The defective part is cut completely out, and the new piece fitted, riveted, and caulked. It is usual to put this piece outside the boiler, next the fire, though this is objectionable, for the reason that the mud finds an easy place of lodgment upon the depression, making it liable to soon burn out, and making business for the boiler maker.

Blisters are formed on boiler sheets where they are exposed to the fire. The different layers of the iron being imperfectly welded, and the water from the boiler finding its way between the laminations, the steam pressure gradually forces them farther and farther apart, until vent is obtained. When one of these blisters is discovered, it should be immediately vented by punching a hole, and in many cases it will be found that little or no water escapes. This is known as a dry blister, and should be cut around and the projecting part removed, and no great harm will be done. If a continuous stream of water escapes, you have a wet blister. You can stick a pine plug in the hole which you have punched, and, as soon as you have the time, cut out the blister, and stop the hole which communicates with the inside of the boiler by tapping in a bolt.

The very best of boiler iron is liable to blister, and in mills where boiler iron is made, the guaranteeing of perfect fire sheets is sometimes a very serious matter. The roller, when watching the plate as it comes through the rolls during the last passes, observes spots which appear hotter or of a brighter red than the remainder of the sheet. If this sheet is for an order of warranted iron, it is cut in such a way, when sheared, that these spots may be removed; or, if this is impossible, the sheet is condemned, or worked into another order where the requirements are not so strict.

Steel, or homogeneous iron is now largely used for the manufacture of boilers. With this material there is no lamination and no blistering, the sheet being rolled from a solid cast ingot. Good metal for boilers will bear bending and flattening when either hot or cold, and a piece of it, when heated to redness and plunged into cold water, should not be perceptibly hardened.

There is one trouble to which steel boilers are liable, even when the metal has passed the above tests, and that is cracking of the fire sheets. When a crack is discovered, holes should be drilled immediately beyond the ends of the crack, so that it may not extend further, and these holes closed with rivets. In some cases the edge of the crack may be closed by caulking, and if this fails, either hard or soft patching must be resorted to.

LETTERS FROM PRACTICAL MEN.

Patenting Old Inventions.

Editor American Machinist:

I was amused in reading the article in this week's issue on patenting the old invention of the car-replacer. They came in use with the introduction of street cars in Philadelphia, in 1854. Besides being useful for replacing cars, they possessed another valuable feature, for they could be laid upon the rails to protect the hose in case of fire. By this means the cars could continue to run without interruption, and not accumulate and interrupt traffic, as is the case in most cities where they are not used. They were made as shown in the accompanying sketch, the cavities *A* being made to protect the hose.

The replacers were kept at convenient points

along the track where they could be found when needed.

The old adages that there is nothing new under the solar luminary, and that history repeats itself, are peculiarly applicable to a large share of patents.

If not encroaching too much, I will give a few samples from my recollections, similar to the above.

Velocipedes were made and hired out to men and boys to ride by the hour, and some of them had a seat behind for ladies, others were made for two persons, and could be worked by hand and foot, either together or separate. This was thirty-five years ago, when I was a somewhat younger boy than I am now, and they seemed to have been in common use before that time. These were made by a man named George Small, who kept a wagon and paint shop.

About two years ago, I received an account of a lawsuit about reversed dies, the parties to which were Fisher and Hayes. The suit was against a party for using dies in reverse; that is, the male die secured to the bed of the press, and the female die secured to the hammer, or drop. Where I served my apprenticeship, in a shop in Philadelphia, from 1853 there was a great deal of drop-press work done, and it was a common practice to use the dies in that way.

Next comes self-heating smoothing or flat-irons, as they are called—a misnomer, for they are far from level, especially when the irate wife throws them at the husband's head. In 1876, a party bought the right to manufacture in Erie and Niagara counties, New York, a self-heating smoothing-iron, patent 1876. The iron was hollow, and made reversible, with holes around the body and a spirit-lamp secured to the back, which was kept lighted while in use. Splendid in theory, but not worth shucks in practice. The purchaser came to me to manufacture them. About the same time another party came to me to see about getting a lot of malleable iron shoes for smoothing-irons ground and polished.

This article has just been patented.

The laughable part now comes in. When I was a boy, in the early fifties, I was possessed of a great liking for labor-saving and curious inventions. Near where I lived, there was a hardware store, which I frequented, that kept all the new-fangled inventions to tempt the unwary and unsophisticated. Amongst other untold wonders, such as self-broiling gridirons, one-minute coffee-pots, &c., I beheld—what? Aladdin's wonderful lamp? Ha, no; it was this self-same self-heating smoothing-iron, the housewife's bosom friend. Was this other shining article that dazzled my sight Cinderella's crystal brogan? No, it was a thin sheet of steel for covering a smoothing-iron, to keep the iron bright and clean, with which to polish the bosom of the old man's *biled* shirt. So, with ducats bright did I the hardware man persuade those treasures to part with, and I hied me home, to my dear mamma, to gladden her eyes with this great surprise. But, picture if you can. my chagrin, when two weeks hence, against the fence that encircled the lot at the rear of our domicile, I saw iron and steel slipper discarded like an old shoe.

The self-heating iron of 1876 was an exact duplicate of that of 1854, and the malleable iron shoe of same date was rejuvenated from the steel slipper of the earlier period, with the advantage on the side of the slipper.

At the exposition of railway appliances in Chicago, last June, was a sleeping-car seat newly patented. The original was patented in 1859, and from the same city.

E. E. J.

Buffalo, N. Y., Dec. 10, 1883.

Mistakes in the Patent Office.

Editor American Machinist:

In the December 15 issue of your paper, in an article called "Patent on an old invention," you say, "this reinventing old and common devices has become a nuisance."

I think you are a little severe, as in this case the party did not know of the device (for he made oath to that effect) being used before, and as he thought of it he had perfect liberty to apply for a patent.

The Patent Office should not have allowed the patent, if they had known of the device being in use before, but they of course did not, as they only had the office records to examine, and are not to be expected to hunt up "old shop kinks," newspapers, magazines and manuscripts, or to have agents or detectives to hunt up evidence.

In the case quoted, and in all similar ones, the "Court" is the place to settle the point of who first made the invention. One thing, I think, should be attended to in the Patent Office, and that is not to issue a claim to one party and then allow the same claim to another, without stating it in the specification, as has been done twice in my case.

On the whole, the Patent Office gets along with very few errors, considering the large business that they do and the badgering of the "agents."

A. S. P.

Raising Water Thirty-seven Feet by Suction.

Editor American Machinist:

In your issue of December 8 Mr. Stewart, of Buffalo, N. Y., contributes an illustrated article on pumping water thirty-seven feet by suction. About three years ago I put a pipe in a well in that city, connecting a Worthington duplex pump, to supply the boilers in the White fire-proof buildings on Main and Erie Streets. The depth was about the same as named by Mr. Stewart and the arrangement of pipe the same. Perhaps this is the place referred to by him. I did not believe it would work until I saw it do so. The party who gave me the idea says he has raised water ninety feet in this way, by using additional air chambers.

WILLIAM F. MORGAN.

Brooklyn, N. Y.

An Appeal for Free Trade and Low Wages.

Editor American Machinist:

I notice an announcement on your editorial page, that you "have no hobby to ride" or "pet scheme to advance." Now, I think you are hardly justified in that assertion, considering what a great hobby you make of protection. I have read several little articles at different times, as to the wages received by machinists in England, which may mislead the public both there and in this country. You give that part of the truth that suits your hobby, but don't go the whole hog and tell us, not only what a man earns, but how far his earnings will go. For instance, you say a machinist in England gets so much, say $9 a week. Now, in America, he may get $15. Here you stop. This is all right, so far as it goes, but you forget to tell us that the $9 in England will buy more food, clothing, and amusement than $15 will in America. You leave this out, which is not fair. Now, I maintain that a good machinist may be just as well off, financially, there as he is here, providing he acts the same in both countries. A man does not leave his home, friends, and nine hours a day, unless he thinks to do better here; and he does do better, there is no doubt, not because the wages he receives are actually more valuable, but that he spends less on beer and other luxuries, on purpose to save a little money, which is his sole idea. After a little time, he begins to see that a working man out here is as good as any other man, is more independent; then he sends for his family, if he has one. His children receive free education, and stand considerably better chances of getting a position than in England, where birth, not talent, is the test. These are the true reasons that this is the best country, and not simply the higher wages paid here.

Now we come back to protection. Why don't you own right up, and say you think that English mechanics are better than American, can do more work and better, too? It certainly looks very much like it, or why protect them? The English mechanic needs no Government aid, no protection from anybody, but is willing to compete against all, merely on his merits: only give him a fair show, and no favor. It is something like running a handicap race. We are put on the scratch, and you get a long start: then we make a dead heat, and often win. Let us both toe the mark, fair and square, and let the best man come in first. Take the heavy tariff off English-manufactured articles and down comes the wages here, injuring, no doubt, a few, but the majority will feel the benefit of cheap food, clothing, machinery and household goods.

America abounds in coal and iron: why not go in for free trade? Make it universal. It may keep you back for a time, but surely the vast resources of this country, together with the acknowledged skill and perseverance of the people will certainly pull you through, and in a few years America will lead the world in everything that is great and good.

HY. T. ROFFE,
Sup't Georgia Machinery Company.
Atlanta, Ga.

Pattern Making.

Editor American Machinist:

Having read the AMERICAN MACHINIST with great interest for some time, especially the letters from practical men, without finding a single line from a pattern maker, although it is clearly indicated that your columns are open to them, it occurs to me that they must be destitute of ink and paper, or surely some of them would have something to say to inform the inexperienced and to place pattern-making before the public.

It is necessary that a first-class pattern maker have a general knowledge of moulding, machinery, and draughting, so that when the draughtsman submits a drawing for his inspection it will not take him a week to make out what it represents, nor a month to contrive how to construct the pattern so it may be moulded. Here somebody may suggest a consultation with the moulder. I say consult nobody. Let the moulder see a drawing, then ask him how he wants the

pattern made, and in nine cases out of ten the answer will be, "You make the pattern right and I will make the casting." Of course there are a half-dozen different ways in which it may be done, but they are all obscure to the moulder, until the pattern begins to assume shape, or is almost complete, then you are greeted with such remarks as these: "Why didn't you leave that flange loose?" "Can't you have that in two halves?" or, "Why don't you give that piece some more taper?" Many times he will insist on changes equal to the construction of a new pattern.

The pattern maker takes into consideration that the casting will shrink, as castings of different shape do shrink, in their own peculiar manner; that parts are to be finished and other parts left rough, makes a proper allowance for finishing, so that when the casting reaches the machine shop it will not be found necessary for the machinist to spend five or six days' extra time in chipping or planing an enormous amount of surplus metal, thus adding to the general expense—all on account of lack of skill and good judgment. WILLIAM HULTGRAN.

Compound Engines on Western Rivers Thirty-Five Years Ago.

Editor American Machinist:

Your correspondent, Mr. Dutton, of Chicago, in his letter respecting "Compound Engines on Western Rivers," need not have confined his dates to 1876.

The first Clipper No. 1 had compound engines, and was built about thirty-five years ago. The Memphis, a well-known New Orleans packet, had compound engines. I made a trip on her as a "striker" thirty years ago.

The Hawkeye, an earlier steamer than either the Clipper No. 1 or Memphis, had "Clipper engines," as they were called, and was sunk by her *fly-wheel* going to pieces and down through her bottom.

The engines were arranged tandem fashion. Dimensions and all lesser particulars are gone from present memory.

J. RICHARDS.

San Francisco, Cal.

Automatic Recording Appliances for Testing Metals.

Editor American Machinist:

Engineers having occasion to use testing machines are all interested in the subject of autographic recording appliances, by means of which an autographic card or record can be obtained, indicating, if possible, the following particulars, viz:

1. The modulus of elasticity under different loads.
2. The limit of elasticity.
3. The maximum load causing rupture.
4. The final load at the moment of rupture.
5. The whole stretch of the specimen.
6. The resilience of the specimen, not only at points up to the limits of elasticity, but also up to the point of rupture.
7. The irregularities of elasticity in different parts of the specimen, indicated by a varying elongation (which is not shown at all by any of the existing machines).

Several devices for this purpose have been invented, and are in more or less common use; but a careful examination of them has convinced us that they are all more or less prolific of error, and that their inaccuracies and variations are so serious as to make it an open question whether they do not do more harm than good. The only decided indication they afford is in regard to the elastic limit, the stretch, the maximum and breaking loads. Even these indications, we think, are not always shown reliably, for reasons which we need not enter upon here. But what the constructing engineer needs chiefly to know is the behavior of his materials before the elastic limit is reached, as it is below this limit that he employs them. Their behavior beyond this point, and up to rupture, is, of course, interesting and instructive, but does not come within the scope of actual practice. The record of existing autographic devices up to the point of elastic failure consists usually of a faint pencil line diverging very slightly from the normal, the amount of this separation at any point indicating the modulus of elasticity of the specimen. These indications, therefore, which are the all-important ones to be ascertained, are very faint, poorly defined and uncertain. The thickness of the pencil line is usually a large percentage of the indication, so that different observers would obtain different readings or indications. Altogether, the results thus obtained seem to us so vague and unreliable as to make it a question whether any of the existing recording appliances can safely be used, and whether it is not better for the present at least, to resort to other means, apparently more crude, but actually far more reliable and instructive, to ascertain the action of specimens under strain.

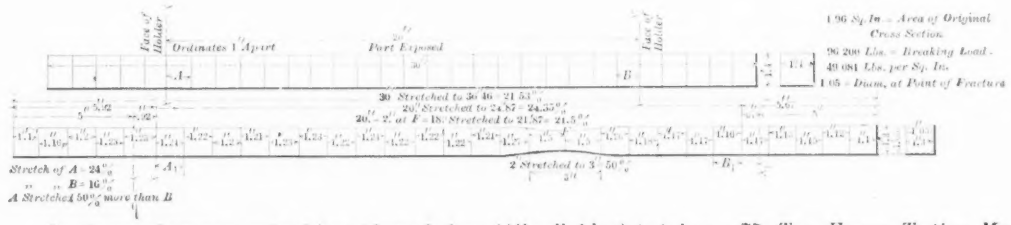
To illustrate our meaning, we hand you herewith a blue print, showing a specimen which was tested during the recent visit of the A. S. M. E. to our works, and ask your attention to the following interesting points it demonstrates: The specimen was originally 30 inches long and 1.4 inches square. It stretches 6.46 inches, which is 21.53 per cent. of the whole length. With some autographic appliances the elongation is measured by the separation of the holders (in this case 20 inches originally), which would thus amount to 32.3 per cent. If, however, two points on the bar 20 inches apart were taken as the basis of measurement, their separation was 4.87 inches, which equals 24.35 per cent. The two inches adjacent to the point of rupture stretches to three inches, which equals 50 per cent. If these two inches and their stretch be deducted from the original 20 inches, the elongation of the remaining 18 inches was 3.87 inches, which equals 21.5 per cent. We thus have five different percentages of elongation according to the basis of measurement assumed. But by examining the elongation between the several pairs of ordinates, we note that few of them are alike, and that, for instance, the inch marked *A*, just outside of the left-hand holder, stretched 24 per cent., while the inch marked *B*, in the corresponding position, adjacent to the right-hand holder, stretched only 16 per cent., the former being 50 per cent. more elongation than the latter.

The preparation of a specimen by ordinates as we have shown, and the plotting of these after the test, together with repeated direct measurements of the specimen during test, by means of micrometer screws applied to measure the actual separation and approach of two well-defined gauging points securely fixed to the specimen, these measurements being made repeatedly under various loads, both increasing and decreasing, and before and after permanent set, undoubtedly afford the most accurate and as yet the only reliable means of noting the action of materials under strain which we at present possess. Ultimately, we think it possible that some form of recording apparatus may be devised which will give reasonably complete, accurate and reliable results: but at present we believe that any engineer, reasonably well-informed as to the behavior of materials under strain, can make guesses approximating more closely to the truth as to the modulus of elasticity and the elastic limit than do the average indications of existing autographic recording devices.

This whole subject is of such importance that we have thought you would be interested in the foregoing, and in the accompanying drawing, both of which you are at liberty to use as you see fit. HENRY R. TOWNE,

President Yale & Towne Manufacturing Co.,

Stamford, Conn.


Face of Holder
Ordinates 1" Apart
Part Exposed
Face of Holder
1.96 Sq. In. = Area of Original Cross Section
96 200 Lbs. = Breaking Load.
49 081 Lbs. per Sq. In.
1.05 = Diam. at Point of Fracture
30" Stretched to 36.46 = 21.53%
20" Stretched to 24.87 = 24.35%
20" at E to B Stretched to 21.87 = 21.5%
Stretch of A = 24%
" " B = 16%
A Stretched 50% more than B
2" Stretched to 3" = 50%

Specimens of common refined iron (dressed from 1½" rolled bar) tested on a 75 Ton Emery Testing Machine before the American Society of Mechanical Engineers, at the works of the Yale and Towne M'f'g Co., Nov. 2nd, 1883. Movement of holder faces, 6.46" which is 21.53% of the 30" bar, but is 32.3% of the original 20" between the holder faces, which some machines would show as the stretch of 20"; x and x are positions of faces of holders, respectively, before and after testing.

Borax for Hardening Steel.

Editor American Machinist:

I have found the use of borax for tempering tools to cut extremely hard metal better than prussiate of potash or cyanide of potash, and would like to know if it is used by others, and if not, why not?

A. J. GREEN.

Need of Simple Rules to Solve Problems.

Editor American Machinist:

Having often been bothered in dividing a circle into parts of equal lengths, I would like to express my thanks to Mr. West for his simple rule given in December 22d issue. If some of your draughtsmen readers would give some simple rules to solve the different problems that continually arise in a mechanic's work, it would benefit a great many who are not posted in geometry or the higher mathematics. A. S. P.

Cyclone Refuges and Double Glasses.

The head of a large machinery establishment in a Western city sends us the following, which, though not intended for publication, is too good to keep:

"When in your office, not long since, some joking remark was made about the feasibility of using old boilers as a 'harbor of refuge' in squally times, but I did not at that time 'absorb' the idea. Since my return to the rural districts, and particularly since I was reminded of the whole affair, Fulton Ferry oysters and all, by reading the article in last week's paper, I think I can now see that it would be a good thing to plant quite a lot of the old boilers now in use at 'points' in the West adjacent to where cyclones are bred and raised. When I remember how dangerous a place 96 Fulton Street is, where the whole crew are liable almost any time to be carried off their feet, and sometimes out of the building, by a 'Western blizzard," it occurred to me that it would be a good thing for the 'staff' if each had alongside his desk an 'old boiler' convenient of access. The flue-sheets might be nicely frescoed, and the sides striped or decorated in some of the prevailing tints. At any time when the storm center should hover over that locality, and you heard on the stairway or in the corridor any ominous sounds, indicating the coming of a Western 'blow-hard,' the signal could be given in time for all hands to hunt their holes, and thus inside your boilers you could in safety find shelter until the thing blowed over or blowed out. In selecting the 'old boilers,' you could work in all kinds.

You would want a couple of long, slim ones for the president and editor, and a shorter, wider one would best cover the treasurer, while the two M. E.'s might be accommodated in an old-style, two-flue Mississippi iron boiler. The boilers might vary as to size and length, but I presume the *horse-power* would not differ much.

"By the way, I have *been told* that in some places they gauge a man as being a one-bottle man, or a two or three-bottle man. I don't suppose that Prof. S. W. Robinson would come under either head, but I see by his article—the Hydrostatic Leveling Instrument—in your December 15th issue, that he can take his two glasses and walk off with any of us, as level-headed as a judge. I don't go much on fluids myself, but I don't believe, if I had ten cents, I would put it in a 'rubber hose,' when I could just as well put it in a couple of glasses."

H. F. Nichols, Master Mechanic's office, Gulf, Colorado and Sante Fe R. R., Galveston, Tex., writes us:

"I will pay any reasonable price for the following numbers of the AMERICAN MACHINIST if they can be obtained: Vol. 1 complete; Nos. 2, 4, 5 and 6 of vol. 2."

Professor Henry Morton, President of the Stevens Institute of Technology, Hoboken, has written a long letter to the New York *Times* on the question whether or not it is impracticable to put electric light wires under ground. He holds that the dangers to life and property from aerial wires have been greatly exaggerated. That in all the time electric lights have been in use there has been only one fatal accident by connection with the current, which happened to an employe of the Brush Company. After careful investigation into the origin of fires from electric light conductors, he was convinced that the few fires originating from this source have been caused mostly by underground wires. The net result of two and a half years' experience shows that this new agent of illumination is very much safer than the old ones it replaces. The experience we have had with both systems leads Mr. Morton to the belief that if carried from place to place under ground the danger from the wires would be increased, since they would have to be brought above ground to the places used. The liability to accidental contact would then be greater than at present. In Paris and other European cities where the underground plan had been tried, the expense of keeping up the system became so great that electric lighting was virtually abandoned. He predicted that should an order be carried out here to place the electric lighting wires under ground the streets of New York will return to the pristine gloom which has overtaken Paris. There is no reason for putting the wires out of sight except on the score of beauty, and he thinks the price to be paid will prove too great for an æsthetic sentiment.

Oberlin Smith, Bridgeton, N. J., writes us: "Your recent editorial upon the 'anvil principle,' prompts me to say that when I used, in your columns, about a year ago, as a text for a sermon upon inertia, the contradistinctive terms, 'anvil principle' and 'fiddle principle,' which have since been somewhat frequently quoted, I supposed them both to be original—not knowing that Mr. Porter, in his excellent paper upon machine tools, had cited the *anvil* as an emblem of solidity. Had I been acquainted with the fact I should have taken pleasure in giving its accomplished author proper credit for the idea, and should have allowed my inventive inner consciousness to vibrate to the tuneful strains of the fiddle only."

The editor of the *National Labor Tribune* writes us to say that we were in error in saying recently that a law in regard to copper tamping rods had been passed in Pennsylvania. The law in question belongs to the State of Illinois, and was referred to by a correspondent of the *National Labor Tribune*.

The troubles with the grip on the Brooklyn Bridge are already bearing fruit in the Patent Office records. Every week brings forth one or more patent grips, and the backwoods are not yet heard from. Should the winter prove severe enough to suspend out-door labor in the rural districts, the spring will usher in an array of patent grips that will leave car couplers, electric lamps and check rowers entirely in the back ground. When anything happens to keep a portion of our population inside doors its effects are immediately apparent in the Patent Office records.

A patent has been obtained by Frank M. Mahan, Chicago, for a process of making spoked wheels, such as are used in ordinary vehicles, of paper pulp. The pulp is forced, under pressure, into a mould of iron, where the wheel is made ready for the tire.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.

JACKSON BAILEY, Vice-Pres't.

LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, ANGUS SINCLAIR, } Mechanical Engineers.

The American News Company,
Publishers' Agents, New York.

The International News Company,
11 BOUVERIE STREET (Fleet Street), LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage prepaid.

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The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton Branch, Clifton, Ontario, Canada.

SUBSCRIPTION.

$2.50 a year, in advance, postage prepaid in the United States and Canada.
$3.50 to Foreign Countries, postage prepaid.

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Transient, 35c. per line, each insertion.
'Business Specials," 50c. a line.

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NEW YORK, JANUARY 5, 1884.

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What Will Help Manufacturers to Compete.

Mechanical industries, as a class, have not been as active and prosperous during the year 1883 as they were in 1882. The volume of business, however, has been great, but the rapid increase of productive establishments and persistent enlargements have exceeded the necessary capacity to supply the demand. Therefore, it is impossible that all mills, shops and factories shall be kept running full of work. Competition becomes closer. This tends towards lower prices, which in turn tend towards lessening the cost of production. How the latter is to be satisfactorily accomplished is now an all-absorbing problem. Most machinery manufacturers have, for the last few years, been improving their shop tools, plants and processes. Progress in this respect has not been uniform, and some who have given but little attention to improvements, while orders were plentiful at remunerative prices, find themselves with limited power for competition. They cannot obtain skillful mechanics at any less wages than their better-equipped neighbors. Other things being equal, good mechanics prefer to work in well-equipped shops. Therefore, the shops that have made but little or no advancement to enable them to do more work, without increasing the number of workmen, are in no enviable condition to withstand a season of industrial depression.

Iron and steel manufacturers are experiencing more competition among themselves than machinery manufacturers. The Bessemer steel mills and a number of the iron mills have cut down the wages of their workmen about ten per cent. As a prominent Bessemer steel manufacturer remarked to us a few days ago, this does not help them to compete with each other in any particular. While no advantage is gained, the workmen are made dissatisfied, and naturally will not be as anxious to put forth their best efforts as before. No more iron or rails will be sold by reason of the wages reduction. Consumers will demand and receive lower prices, and the mills will not secure any larger margin of profits. Improvements in the processes of making iron and rails will alone help the mill-owners to compete, and those who are first in securing those improvements will have the greatest advantage.

The general reduction of wages, by a uniform scale, has an unfavorable influence upon the establishment taking such action, as well as upon the trade.

Tariff Considerations.

Among our "Letters from Practical Men," this week, is one from an enterprising English mechanic, who has been in this country only a few months, making an appeal in favor of free trade. We publish the letter in full, as we have no desire to dodge criticism upon any position we take in these columns, whether regarding the tariff or any other important issue.

Our correspondent does not dwell upon any presumed advantages to be gained by adopting a free-trade national policy, but tries to point out that although we should be kept back "for a time" by discarding our protective tariff we should eventually be able to "pull through." He very truly declares that if the tariff is taken off English manufactured articles "down comes the wages here." Those workmen who are anxious for free trade and a tumble in wages in the fond belief that they will be enabled to buy the necessities of life cheaper than at present, better stop and consider some of the most obvious economic truths. When an industrial squeeze is experienced wages are about the first to feel the change, and are promptly cut down. Rents, clothing and provisions decline very slowly, and never in a greater degree than wages. Even if everything the workman has to buy should decline in price, proportionately to the decline in his wages, it would not benefit him. A new trouble would arise for every one in debt, be the amount small or large. While the sum he could save every week would be less the dollar is a fixed thing. It would purchase more in the market, but would not pay a particle more of debt. Workmen who had purchased dwellings or other property, basing their intended payments on present earnings at about their full ability to pay, would be sadly pinched. If general prices should decline one-third, every workman in paying debts would have to give the proceeds of *three* days' labor for what was *worth only two* days' labor when the purchase was made. This would ruin tens of thousands by causing them to lose what they had partly paid for. The adoption of free trade would produce this result. The so-called "revenue reformers," however, would only impoverish the workmen gradually by paring away the tariff by instalments.

Our correspondent very truly notices the greater independence of a working man in America. After discovering the benefits of our better social and industrial system, it looks a little peculiar to see him advocating the adoption of one of the *chief elements* of the British industrial system, under which workmen are regarded as belonging to an inferior class—a system which he was glad to leave behind him.

Our Atlanta critic seems to have imbibed the idea that Congress ought not to legislate exclusively for the interests of the people of this country, but ought to give the English mechanic "a fair show" by throwing off the tariff, thus making it easier for him to compete with our own mechanics. This idea is not original with our correspondent, but it is peculiar, to say the least. Perhaps it will be duly considered by Congress this winter.

A reader asks whether in writing or describing anything for publication in the AMERICAN MACHINIST, he must make it grammatically correct, or whether it will be corrected before printing in the paper. All we require a correspondent to do is to set forth his ideas intelligently. Mistakes of spelling or grammatical construction of sentences are easily corrected by us. No one need refrain from writing on practical matters for our columns because he lacks a knowledge of grammar.

Effects of Scale on Boilers.

When the Railway Master Mechanics' Association was investigating the subject of the effects that hard water had on boilers, several years ago, scientific experts gave reports that lime scale being a poor conductor of heat, its presence diminished to an alarming degree the evaporative efficiency of the hot gases. This appeared reasonable enough, and was accepted as true, the prevailing belief being that one-eighth of an inch of scale will decrease the efficiency of the boiler about one-half. Like a great many other accepted doctrines, this one is probably founded on a fallacy.

Some recent experiments, very carefully conducted, were made in Bavaria, where coal is expensive, to test the loss of evaporative efficiency due to incrustation of boilers. The experiments were first made with clean water, then with water impregnated with gypsum, which deposits sulphate of lime, the worst scale known to our American waters. The experiments with the gypsum-laden water were continued without interruption for 195 hours, when indications appeared of the furnace sheets being red-hot. An examination showed that a scale ranging from $\frac{1}{4}$ to $\frac{3}{8}$ inch thick covered the sheet, but it had not caused any reduction in the evaporative efficiency of the boiler.

Furnace sheets subjected to conditions of this kind would soon burn out, but the destruction of the sheets seemed the only source of loss.

That there is a false impression about the loss of evaporative effect due to scale we have long felt certain; for we have repeatedly seen locomotive boilers nearly solid with incrustation and sediment, yet the steaming capacity of the engines was not perceptibly affected. Scale is certainly ruinous to heating surfaces, and is responsible for two-thirds of the repairs needed to boilers, in some of the Western States; but there is evidently a wrong impression about its injury to the steaming power of boilers.

A striking effort is being put forth to extend the aid of mechanical science to dairying operations. A patent has been secured for a whole combination of elaborate machinery for milking cows. Should the scheme come into practical operation, a steam engine will be used to run an exhaust pump which will draw the air from a chamber connected by tubing to accumulating bulbs that are intended to receive the milk from rubber teat covers. The inducements that will be used to persuade the cow to deposit her milk in the accumulating bulbs are not very clear to us, but probably the inventor understands it. An inmate of this office once had a friend who entered this promising field of invention. He got out a milking machine, and it seemed perfect in every particular till it made the acquaintance of the cow. She strongly objected to the arrangement, and after dealing the inventor a stunning kick, started for the woods with the patent milker hanging to its point of attachment. The animal seemed to think the spirits that got into the swine of holy writ had hold of her milking apparatus, for her race reached a similar conclusion.

The following extract from a letter just received by us, from the superintendent of a shop in the interior of the State of New York, is a sample of many others that we are now receiving:

"I wish to present some of my men with the AMERICAN MACHINIST for the year 1884.

"In forwarding the above list of names, they were all given their choice of any mechanical paper or periodical published in the U. S., and were unanimous in favor of the AMERICAN MACHINIST, pronouncing it the best, most useful and comprehensive paper published; in which their superintendent heartily joins."

Literary Notes.

THE TABOR STEAM ENGINE INDICATOR. By George H. Barrus, S. B., New York: Ashcroft Manufacturing Company. Price, $1.

One of the objects for which this book was prepared is to describe the Tabor indicator, sold by the publishers, and to give the purchasers and users of this instrument instruction in its use and care. The manner of connecting the instrument to the cylinder of the engine is illustrated and described, as well as means of giving motion to the paper drum. The application of the instrument to the locomotive is considered, and diagrams illustrating locomotive practice given. The method of computing the horse-power of an engine by dividing the diagram into an equal number of parts, and also by the use of the planimeter, or averaging instrument, is illustrated. A method of computing the amount of steam accounted for by the indicator is given, and for constructing on the diagram the hyperbolic curve. Useful tables of areas of circles and properties of steam are included; also tables of engine performance and cylinder condensation. As may be inferred, but a small amount of the matter refers to the use of any special indicator, but is general in its character.

The Christmas number of the *American Bookseller*, for 1883, published by the American News Company, New York, contains a large number of specimen illustrations from new books, which are now offered for the holiday trade, together with such descriptive sketches as will give prospective purchasers an idea of the quality, style and scope of the various books from which they are taken. The publication is not only a very useful one in this way, but it is of itself a handsome and valuable work, well worthy of careful reading. It can be ordered through any newsdealer.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(1) W. J. E., West Milton, Ohio, writes: have a large grindstone that has two soft spots. Can you tell me of anything to keep these spots from wearing low? *A.*—We know of no way.

(2) S. E. D., Manchester, Conn., asks: Will you please inform me whether a pistol-ball will penetrate a substance the farthest at a distance of five or fifty feet from the muzzle of the pistol? *A.*—At five feet.

(3) H. H., Scarborough, N. Y., asks: Which will expand the most in length, at equal heat: a piece of iron one inch diameter and one foot long, or a piece two inches diameter, of the same length? *A.*—If the quality of iron is the same in both pieces, the expansion will be equal.

(4) H. C., West Lynn, Mass., asks: Is it correct to say a thread is chased, when it is cut by the use of a V tool and gearing in an engine lathe? *A.*—There is no rule or law except custom in this respect, and it has become customary in many localities to call the operation of cutting screws in an engine lathe, chasing.

(5) J. G. O., Chicago, Ill., asks: Is there an injector for feeding a boiler by which the supply of water can be regulated the same as with a pump? *A.*—The quantity of water fed can, within certain limits, be regulated in any good injector. If you get the proper size you will have no trouble in this respect. The supply cannot be regulated to the same extent as with a pump.

(6) W. W., Rondout, N. Y., asks: How can I make an eccentric of 5″ or 5½″ throw? *A.*—In an eccentric of 5″ throw, the center of the hole for the shaft is 2½″ from the center of the outside of the eccentric: in one of 5½ throw, 2¾. In other words, if you were to turn a disc, and then lay out and bore a hole for the shaft 2½″ from the center of the disc, you would have an eccentric of 5″ throw. Similarly, for a 5½″ throw, the distance would be 2¾″, and so on for any throw desired.

(7) W. S. H., Morgantown, W. Va., asks: How far from the fulcrum should the weight on a safety-valve lever be to blow off at 95 pounds, the dimensions being as follows: Diameter of valve, 2½″; distance from center of fulcrum to center of valve, 2½″; weight, 30 lbs.? *A.*—No exact calculation can be made without taking into consideration the influence of the weight of the lever. The best plan is to set the safety valve by the steam gauge, as any calculation you may make will not be accurate enough to place much dependence upon.

(8) W. E. R., Arlington, Mass., asks: Is there a gain in carrying 80 pounds of steam for a throttling engine where 40 pounds will do the work? In other words, is there a gain in carrying high boiler pressure and throttling down? *A.*—Generally speaking, there would be a loss from carrying pressure so much above that required. There is sometimes a gain from throttling, to a limited extent, with the governor, when the construction of the engine and governor is such that an indicator diagram will show a comparatively high initial and low terminal pressure; in other words, operate something like an engine with expansion valves. There is also believed by many to be a small gain in a limited amount of throttling from a slight superheating of the steam.

(9) Subscriber, Los Angeles, Cal., writes: Please give your opinion of setting a tubular boiler so as to return the heat over the top of the shell under an arch of 8 inches? In our section saving fuel is a great object, and would we not save enough to compensate for any injury that might be caused by this way of setting? *A.*—We do not approve of the plan, and with a boiler properly constructed and set, there is no saving, and there may be an absolute loss. We have known of boilers set in this way and run for years without any apparent damage; and again, we have heard of serious damage resulting from this way of setting. No saving of fuel will compensate for making a boiler dangerous.

(10) L. L. S., Trinidad, Col., writes: 1. I have charge of a boiler 48″ diameter, and 20 feet long, with 4 flues 9½″ diameter. The boiler has three lugs on a side, which rest on plates in the brick work. The boiler is fed with hot water at the back end. There have been four new half sheets put on the front, and the present sheet has ten cracks from the rivets out. Can you tell me how to repair the cracks, and the cause of them? *A.*—Nothing but a careful examination can reveal the probable cause. Perhaps the fire is too near the shell. If good work is done, and fire-box iron used, and boiler kept clean, there would be no trouble. There is no way you can repair the cracks. You should have the matter looked after by a competent boiler maker. 2. What conditions are necessary for burning coke under a boiler? *A.*—No special conditions except plenty of room between grates and boiler. 3. Where can I get full information about burning all kinds of fuel? *A.*—The information you ask for is not published. 4. How can I test the quality of lubricating oil? *A.*—There is no method that can be very satisfactorily employed, except to try it by actual use. 5. What is a good way to clean waste? *A.*—It costs more to clean it than to buy new.

(11) J. R. S., Petersburg, Va., asks: 1. What is the heating surface of a boiler 5½ feet diameter and 14 feet long, with 90 return tubes, each 4 inches diameter and 14 feet long? *A.*—We do not see how so many tubes can be advantageously located in a shell of that diameter. The heating surface would be: In shell, 121 feet; in heads, say 8 feet; and in tubes (inside surface) 1231 feet—a total of 1360 feet. Allowing 12½ feet of heating surface for a horse power, the boiler would be nearly 110 horse power. This would call for a grate surface of nearly (40) forty square feet, which would hardly be practicable. We should say there were too many tubes in the boiler. 2. How much water will the boiler hold with the tubes in, and with them out? *A.*—The shell, without the tubes in, will hold 2,487 gallons; with the tubes in place, 822 gallons less. 3. What will be the loss of pressure in a steam pipe 15 to 20 feet from the boiler; that is, if I put a steam-gauge on the boiler, and another on the pipe of the engine, will they register the same pressure? *A.*—If the gauges are at the same height, and correct, they will register the same when the engine is not running. With the engine running the difference in pressure will be in proportion to the length and diameter of the pipe, the number of turns in it, the temperature of the surrounding atmosphere, the degree to which the pipe is protected, &c. This difference may be only a fraction of a pound, or it may be several pounds. 4. If the gauges show alike with the engine in motion, where will be the loss? *A.*—From condensation

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

James W. See, Consulting Engineer, Hamilton, O.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass

F. VanWinkle, Mech. Engin'r, 22 Cortlandt St., N. Y.

Patterns & Models, G. D. Lambert, New Haven, Ct.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

"Tack Machinery"
Willets Manufacturing Co., Providence, R. I.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh Wells, & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C.C.Hill, 144 LaSalle st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

For sale, lathes of best designs from new patterns. George A. Ohl & Co., E. Newark, N. J.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Slide Valve Working Models. Send for circular. See notice in this paper, October 18, page 9. E. E. Roberts, 107 Liberty Street, N. Y.

Jack pump and ladder chain machines, 40 to 80 links per minute, direct from coil. The Gaylord, Cross & Speirs Company, Waterbury, Conn.

The "Wax Process" engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

H. O. Reinhardt, M. E., Mem. Am. Soc. Mining Eng., Chihuahua, Mex., invites correspondence of man'frs of machinery desiring to introduce same in Mexico.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

"Catechism of the Locomotive."
The most complete and easily understood treatise on the locomotive; 625 pages, 250 illustrations. $2.50. For sale by "The Railroad Gazette," 73 B roadway, New Yor.

Wanted—Second-hand iron planers, large swing screw-cutting lathes, and drill presses, in good order. Parties having these for sale or exchange for new machinery, please address, with full description, maker's name, and bottom cash price. W. A. James & Co., 275 So. Canal St., Chicago, Ill.

"HOW TO KEEP BOILERS CLEAN."—A book of seventy-two pages, telling how to prevent scaling, foaming, priming, and burning, with other valuable information, will be sent to any address FREE of postage, by James F. Hotchkiss, 86 John street, New York.

Any of our readers who have complete files of Volumes I. and II. in good condition, bound or unbound, can probably find a purchaser by addressing us, and stating the lowest price they will accept. AMERICAN MACHINIST PUBLISHING COMPANY, 96 Fulton street, New York.

Patent "Common Sense" Binder for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address, in the United States, by mail for one dollar. To Canada and foreign countries 75c., the purchaser to pay custom-house duties and express charges. American Machinist Publishing Co., 96 Fulton street, New York.

EXTRACTS FROM CHORDAL'S LETTERS, containing nearly 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with additional illustrations, many of them humorous and all effective—over 50 in all. Just the thing for a holiday or birthday gift. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

MANUFACTURES.

There is a project in Lowell, Mass., to erect a large rolling mill, to employ 1,500 hands.

Gleason & Allen are building a new factory at Terryville, Conn.

A woolen mill is to be established at Rapid City, Dakota.

Maisley & Avery will soon start a cotton-seed oil mill at Monroe, Ga.

The prospects of a cotton factory in Pine Bluff, Ark., are said to be very encouraging.

One hundred thousand dollars have been subscribed for a new cotton mill in Dalton, Ga.

The machine shop upon the site of the Kearsarge Mills, at Portsmouth, N. H., is nearly completed.

Greenville, Pa., has raised $13,000 to induce the woolen mills at Harmony to remove to that place.

William Deering has bought the grounds and plant of the North Chicago Malleable Iron Company for $18,000.

It is said that the Edgar Thompson Steel Works, of Pittsburgh, will soon substitute natural gas for coal under 100 steam boilers.

The Medart Pulley Company, of St. Louis, have gone into the manufacture of turned shafting in addition to their pulley business.

The new works now building in Chicago for the Ellithorpe Air Brake Co. (manufacturers of elevators) will be ready for occupancy about Jan. 1.

Cleveland has been given an opportunity for securing the location of safe works. James White, of Canton, Ohio, is the projector. It is proposed to expend $50,000 in the plant.

The *Alvord (Tex.) Messenger* says: It is well understood that parties have made an arrangement to build a $10,000 custom flouring-mill and cotton-gin at this place in the near future.

Stories of great depression and the wholesale discharge of workmen should be taken with a grain of allowance. Many of these stories are made up for particular effect.

The Whitney Paper Co., Holyoke, Mass., not content with making 20 tons of fine writing paper every day, are about to build an addition to one of their mills 106x49 feet, three stories high.

A stock company for the manufacture of hollow ware has been formed in Pittsburgh, Pa., to be known as the Standard Manufacturing Company. The capital stock is $200,000.

Ground has been purchased at Chattanooga, Tenn., for a new furnace, having a capacity of 100 tons a day. It is said that Mr. J. Lane, of Athens, and Senator Jos. E. Brown are interested in it.

The Mahle Boring Machine Co. is a new Cleveland enterprise. Its capital is $250,000, and its incorporators are Charles Wasson, A. Everett, G. N. Robinson, George W. Morrill, and C. A. Mahle.—*Trade Review.*

Chapman, Rice & Fisher have lately opened a machine shop in Des Moines, Iowa. They will make a specialty of repairing printing presses, engines and machinery. They also have a brass foundry.

The New Erie Gauge Co., Buffalo, N. Y., are just moving into their new building, which has a floor space of thirty thousand square feet. They intend to increase their facilities very extensively during the Winter.

The Adams & Westlake Co., Chicago, will build a five-story addition to their factory, at a cost of $15,000. They will also occupy a new factory building 75x100 feet, six stories, to be erected on Ontario Street, at a cost of $50,000.

The Cleveland, Ohio, Crucible Steel Works have been bought by Daniel McGarry and a company composed in part of the late owners, who have organized into the Cleveland Steel Company, to manufacture the same class of goods as at present.

Hill, Clarke & Co., Boston, Mass., have issued a catalogue of light machinery and machine shop supplies. The volume has over 150 pages, and is well printed and attractive. Many of the articles shown by the illustrations are entirely new. The catalogue is conveniently indexed.

Miller, Metcalf and Parkin, of the Crescent Steel Works, Pittsburgh, Pa., are building a new melting furnace, which will, it is said, be the largest and most complete furnace in the country. The company is also erecting a new machine, carpenter and blacksmith shops.

It is understood that the Patten Car Works, at Bath, Maine, which have been idle for several years, are to be started up by a New York capitalist, with the co-operation of the Messrs. Patten. About $40,000 worth of new machinery will be put in, and the manufacture of cars commenced on a large scale.

At Thompsonville, Conn., a glue and emery enterprise is a prospective new business, as it will bring a machine shop, which is badly needed. The casket company here is about joining a combination of southern and western manufacturers of caskets.

The Straight Line Engine Co., Syracuse, N. Y., write us: We are finishing up two 55 H. P. engines to go to Savannah, Ga., for the Brush Electric Light Co., to be shipped this week, and one 60 H. P. to go to Chili to drive Brush electric lights. The latter is to be shipped Jan. 1. Our American Institute exhibit has sold us four engines already.

The Korting Condenser has recently been furnished to the following parties, by A. Aller, 109 Liberty Street, New York: Rock Manufacturing Company, Rockville, Ct.; C. M. Robertson, Montville, Ct.; G. H. Nichols & Co., New York; Stevens & Thompson, North Hoosick, N. Y.; Walloomsack Paper Company, Walloomsack, N. Y.

Graham & Johnson are building a new factory 32x100 feet in size, on the southeast corner of Adams and Clinton Streets, where they will have enlarged facilities for the manufacture of all kinds of brass work. New machinery, costing several thousand dollars, will be added. It is expected that these works will be ready for occupation about February 1st.—*Chicago Industrial World.*

Thomas Shanks & Co., the well-known machine tool builders, of Johnstone, Scotland, write us "We peruse Mr. Grant's articles on milling, with interest. As we have done something large in that way, we will send you particulars and a sketch of a milling machine, with a 16-foot diameter cutter or cutters, that we made eight years ago for John Elder & Co., with prices of work done per square foot as against planing."

The Knott & Harker Manufacturing Co. have bought the property between Brighton Street and the Marginal railroad, bounded on the north and south by Oak and Beach Streets; also seven lots on the opposite side of Brighton Street. On Tuesday the company staked out the buildings. The main building or foundry will be 100x75 feet, and will be built of stone and wood. In addition to this building will be a large warehouse, and other buildings will be erected when needed.—*Beaver Falls (Pa.) Tribune.*

In reply to a letter of inquiry about the new shops for the Pittsburgh Division of the Baltimore & Ohio Railroad, we have received the following information from Mr. J. E. Sampel, assistant master of machinery: There is now in course of erection at Greenwood, near Pittsburgh, a round-house of 11 stalls; machine shop, 120x124 feet; blacksmith shop, 100x96 feet; car and paint shop, each 100x6 feet, and a 60 feet transfer table between car and paint shop. The round-house will be of brick, and slate roof. The other buildings will be of centennial iron, covered with corrugated iron and shate roofs.

"The new Deane pump at the Lynn Water Works was tested, Friday, by Supt. Lyon and the engineer," says the Lynn (Mass.) *Evening Item* of Dec. 4. "The requirements of the pump were three million gallons a day, with a duty of sixty millions. The test showed the gross capacity to be 3,198,324 gallons, and the net 3,060,392 gallons, with a duty of 62,512,285 pounds to one hundred pounds of coal. Everything about the engine and pump are satisfactory, and it is considered the best in the State."

The illustrated catalogue of American machinery and tools, recently issued by Charles Churchill & Co., 21 Cross Street, Finsbury, London, E. C. (New York office, 95 Greenwich Street), is the most complete of its kind for foreign circulation that we have ever seen. This firm has been doing a very large business in introducing American machinery and tools in Great Britain, probably much larger than any other firm in that line. They write us: "We issue 10,000 catalogues every year, besides advertising regularly in about thirty different journals. We attribute our success largely to our liberal advertising, and having the best goods in the world to fill our orders with." The catalogue has over 200 large pages. Charles Churchill & Co. are agents for the following well-known manufacturers: American Machine Company; American Watch-Tool Company; Bartholomew, G. W. & H. S.; Barnes, W. F. & J.; Betts Machine Company; Boynton & Plummer; Brown & Sharpe Manufacturing Company; Charles Parker Company; Coupe, William, & Co.; Cushman, A. F.; Darling, Brown & Sharpe; Disston, Henry, & Sons; Enterprise Manufacturing Company; Goulds Manufacturing Company; Hendey Machine Company; Holland & Thompson; Horton, E. & Son Company; Hurlbut & Rogers; Interchangeable Tool Company; Jennings, C. E., & Co.; Lowell Wrench Company; Millers Falls Company; Morse Twist Drill and Machine Company; Oneida Steam Engine Company; Peck, Stow & Wilcox Company; Pratt & Whitney Company; Reed, F. E.; Rollstone Machine Company; Saunders', D., Sons; Seneca Manufacturing Company; Slate, Dwight; Stanley Rule and Level Company; Starrett, L. E.; Stephens' Vise Company; Sweetland Chuck Company; Trump Brothers Machine Company; Union Stone Company; Wiley & Russell Manufacturing Company.

Machinists' Supplies and Iron.

NEW YORK, December 20, 1884.

The general supply business is not particularly lively, the holiday season, with the unsettled condition of trade generally, having a tendency to decrease transactions.

In American pig iron the conditions are substantially unchanged, the unwillingness of users to carry surplus stock continuing. Dealers, however, are determined to hold prices steady, even at a still further reduction of output. In prices we quote—No. 1 X, $20 to $20.50; with choice brands held somewhat higher. No. 2 X, $19 to $20.

In Scotch pig business is inactive, with a slight tendency of prices to favor buyers, the cheapness of American brands restricting sales. We quote—Coltness, $22.50 to $24; Glengarnock, $21.50; Gartsherrie, $23; Summerlee, $22.50; Carnbroe, $21.50; Eglinton, $20 to $20.50. These are prices at yard. In most instances orders to arrive are accepted at $0.50 less.

The price for steel rails is nominally $35, but orders have undoubtedly been placed at a lower figure.

Antimony is in fairly good demand, and prices steady. We quote—Hallett's Brand, 10¼c. to 10½c.; 11¼c.

In Copper the demand is limited, but prices rule steady at—Lake, 14¾c.; other brands, 14c. to 14⅝c.

Lead rules dull, with sales of small jobbing lots at 3.65 to 3.70c.

Spelter—Refined, 8c. to 8¼c.

In tin the market is fluctuating, and prices somewhat irregular. We quote sales of—Banca, 20½c.; Straits and Malacca, 18⅛c. to 18¾c.

Boiler plate is weak, with sales of Tank at 2 4-10c. to 2⅝c.; refined, 2¾c. to 2 9-10c.; shell, 3c. to 3¼c.; flange, 4c. to 4¼c.; extra flange and fire box, 4½c. to 5c., open hearth steel, 5¼c to 5¾c.

✲WANTED✲

"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue.

Wanted—By a machinist, situation as foreman or superintendent. Best of testimonials as to character and ability. Box 428, Fitchburg, Mass.

Situaton wanted by a first-class machinist and tool-maker. Specialty, watch and clocks factory. Best reference. Address Box 8, AM. MACHINIST.

Wanted—A foreman for a jobbing foundry in Connecticut, employing 12 to 20 moulders. State experience and expectations. Address F. B., care of the AM. MACHINIST.

A first-class tool and model maker desires a situation. Am capable of constructing and designing tools, fixtures, fine machinery, etc. Experienced in management of men. Address Box 2, care AM. MACHINIST.

Wanted.—Two first-class Wood Pattern Makers. Apply to or address, giving age, experience, and wages expected, The Yale & Towne Mfg. Co., Stamford, Conn.

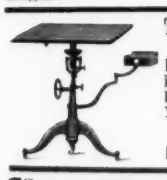
Wanted—A first-class mechanical draughtsman for a machine shop in Chicago. He must have had experience, and be capable of figuring materials. He must also be active, and not over 35 years of age. A good salary and a permanent position to the right man. Address C. C., Box 12, care of AM. MACHINIST, giving experience and references.

Wanted at once—Two first class experienced mechanical draughtsmen. Experience considered as first qualification. Foreigners who cannot talk and understand English will please not apply. Address, giving full particulars, as to years of practice, character of work done, wages expected, &c. Brown & Sharpe Mfg. Co. Providence, R. I.

Amateur Mechanics—Model engine castings, stationary, locomotive, and marine, from $1.75 per set. J. Gilbert, 211 Tenth Avenue, New York.

For Sale.—Patent for bending straw-board for heavy or light paper boxes, without cutting. Will bend or fold any stock without breaking. The whole, or shop rights for sale. Address Paper Box, Box 7., AM. MACHINIST.

To Engine Builders—A party having the best automatic cut-off engine in the market, wishes to arrange with a manufacturer possessing facilities for the best work, to build and introduce it as his lead ing specialty. Sizes to 24 inch in stock, larger sizes to order. Address at this office, "Automatic Cut-off Engine."



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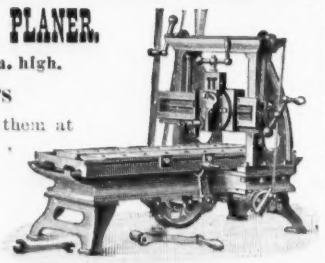

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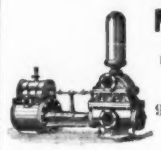

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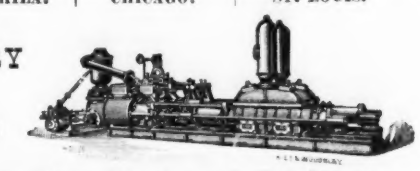

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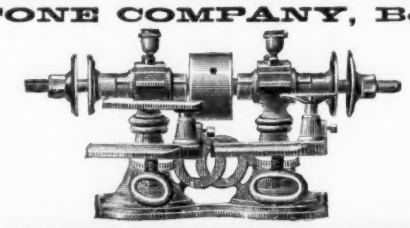

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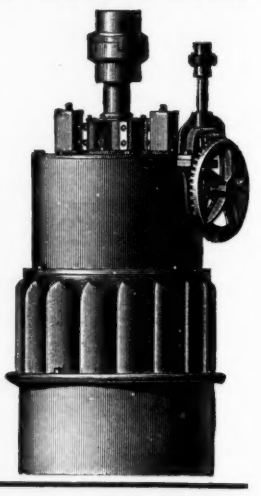

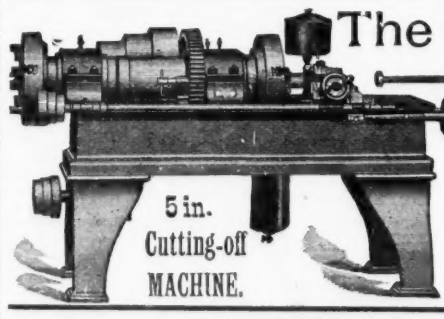

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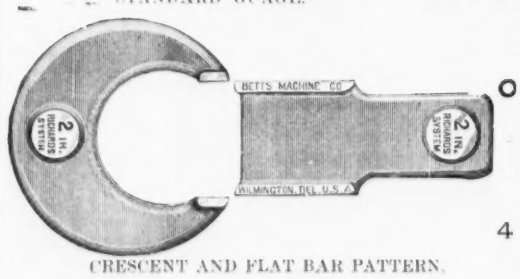

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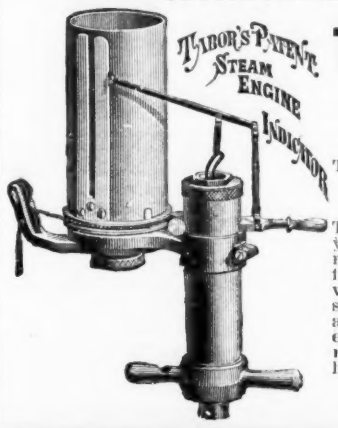

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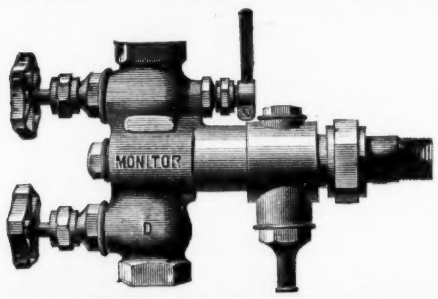

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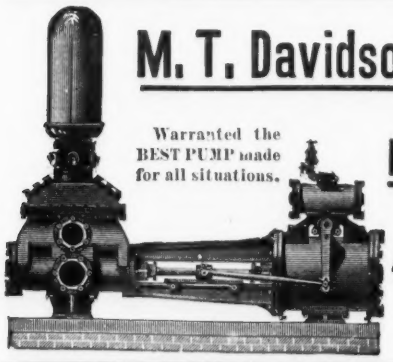

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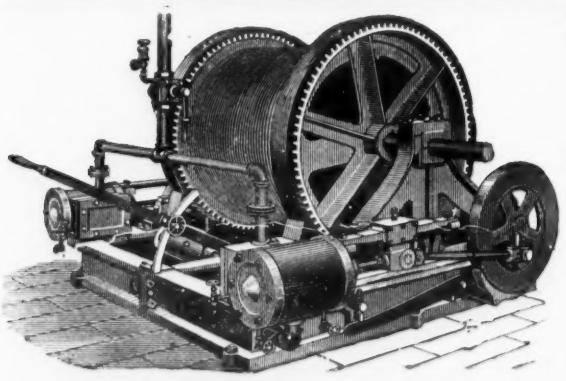

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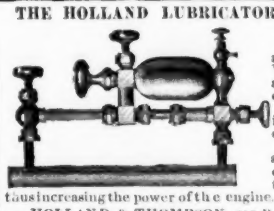

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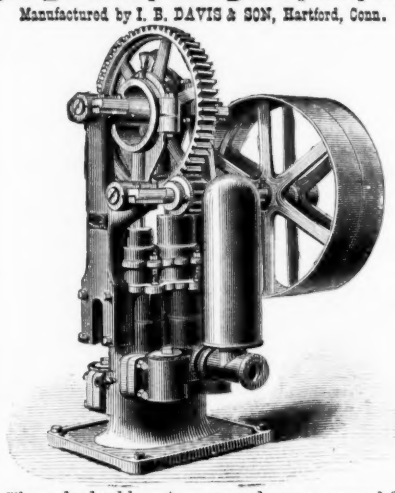

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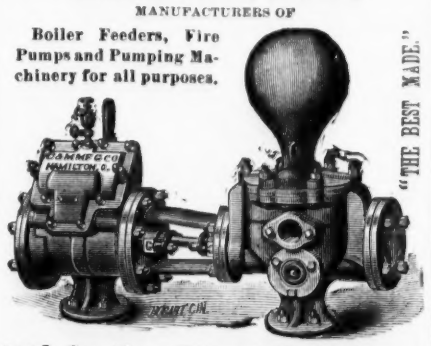

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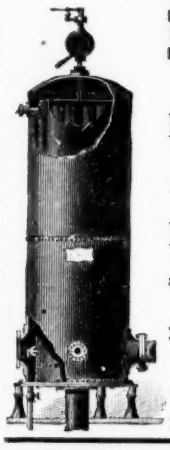

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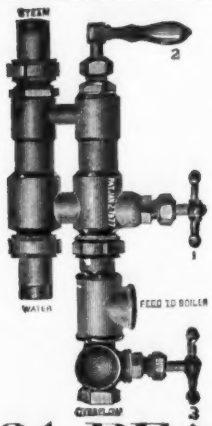

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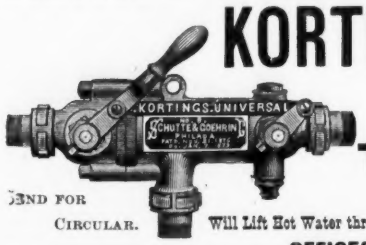

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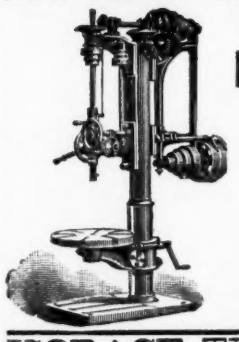

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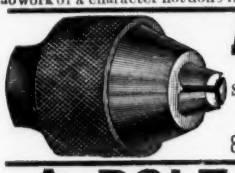

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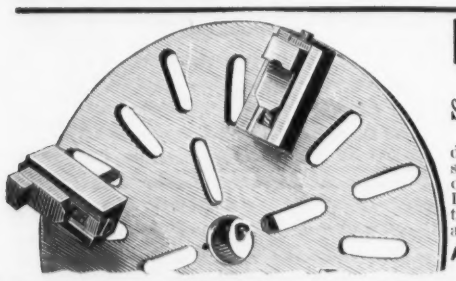

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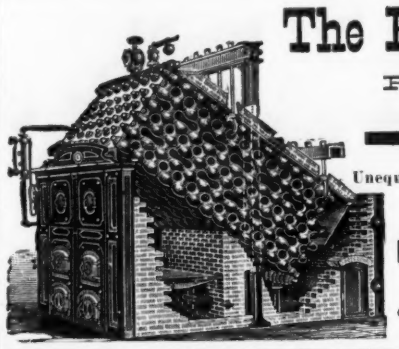

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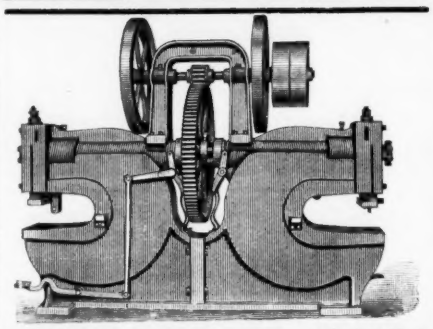

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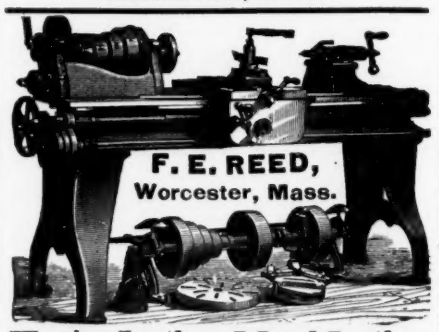

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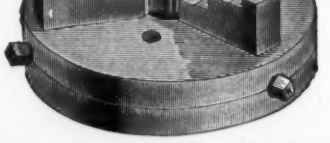

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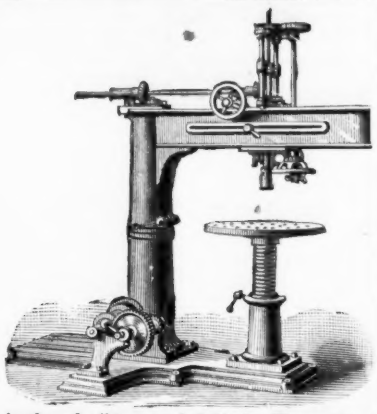

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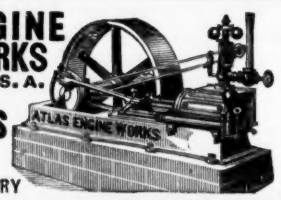

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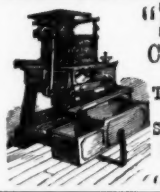

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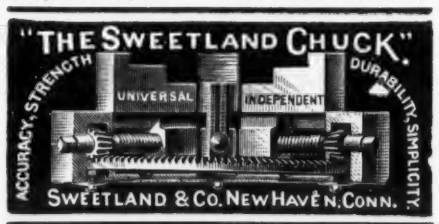

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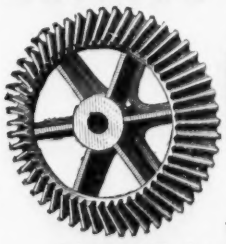

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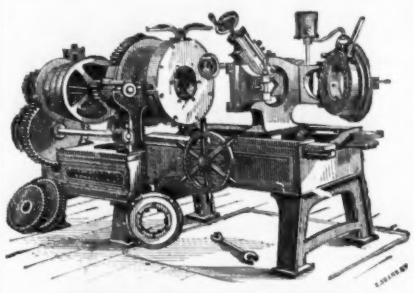

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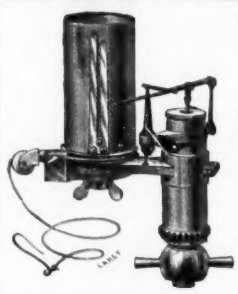

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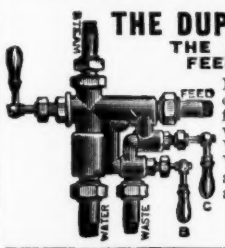

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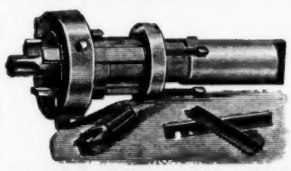

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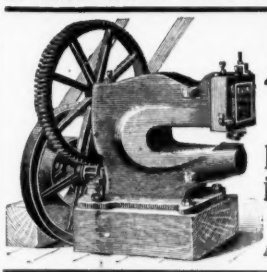

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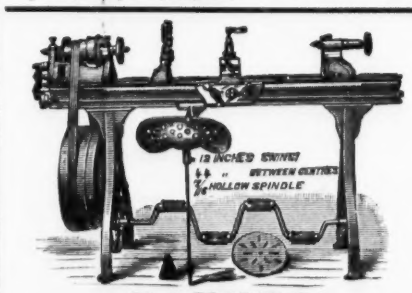

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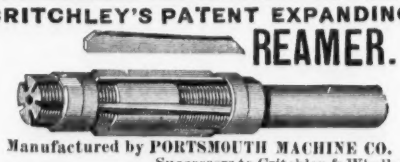

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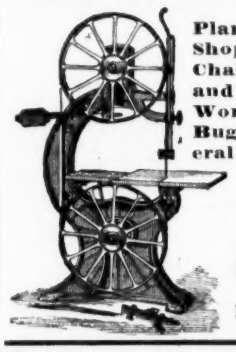

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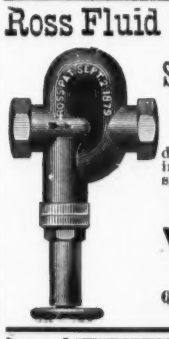

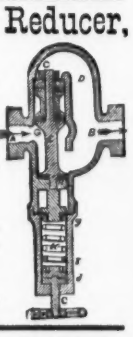

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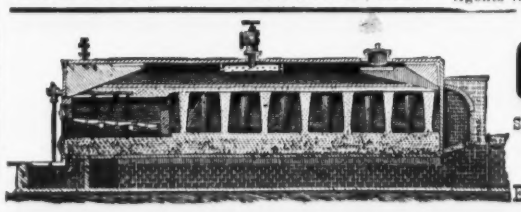

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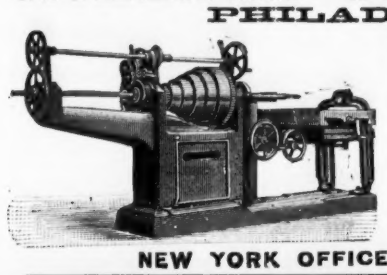

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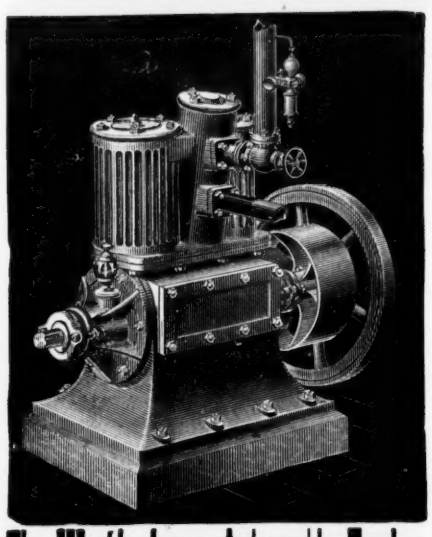

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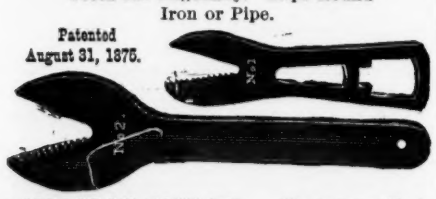

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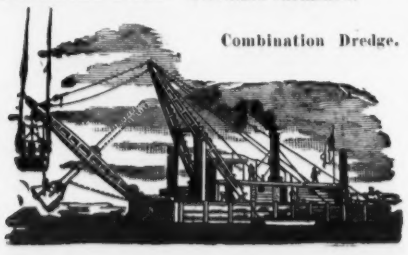

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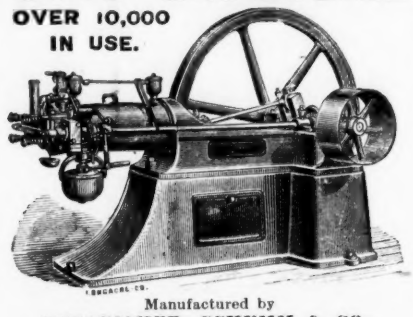

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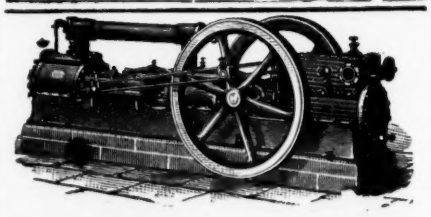

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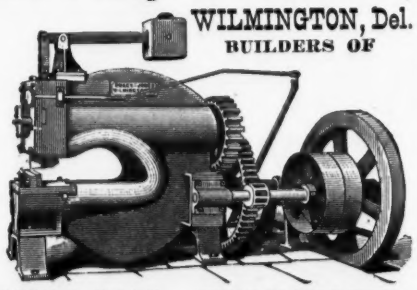

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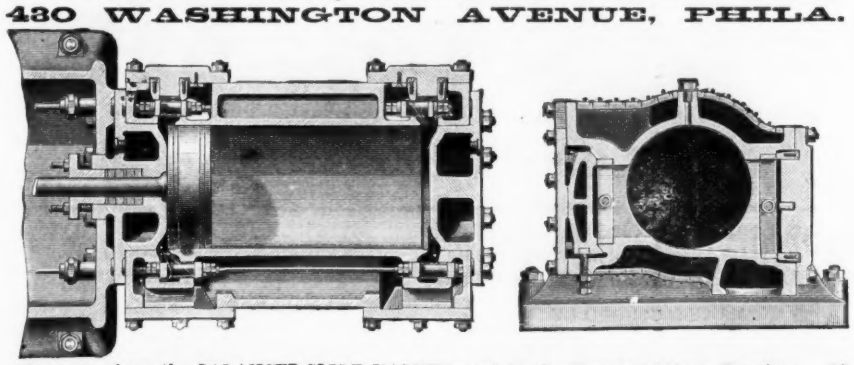

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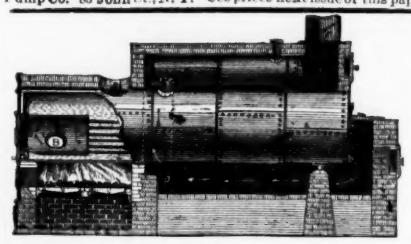

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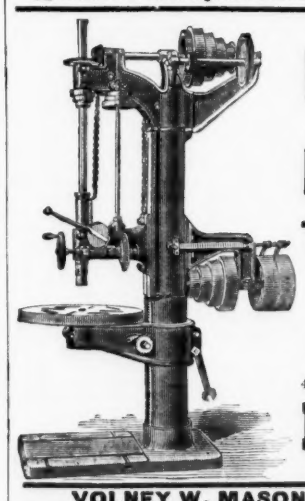

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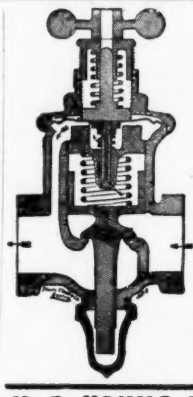

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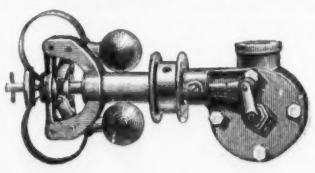

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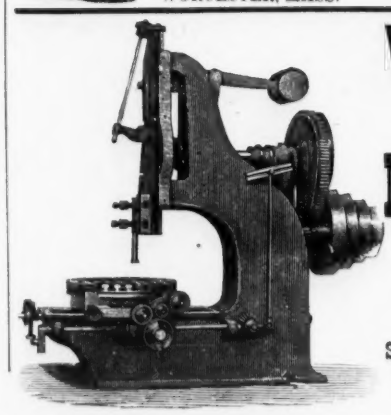

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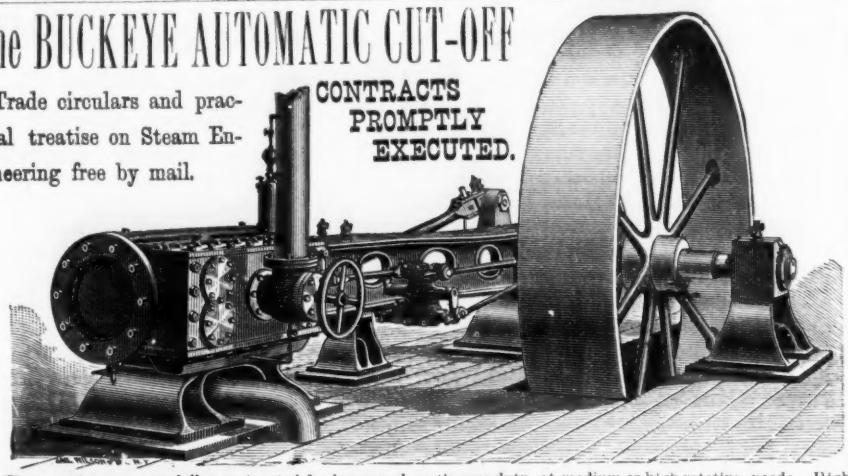

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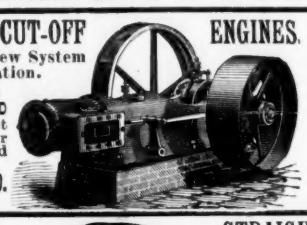

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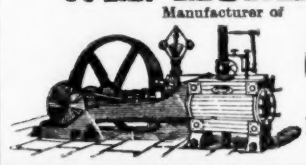

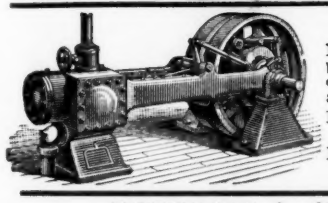

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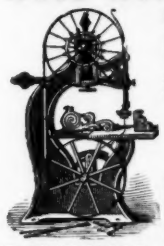

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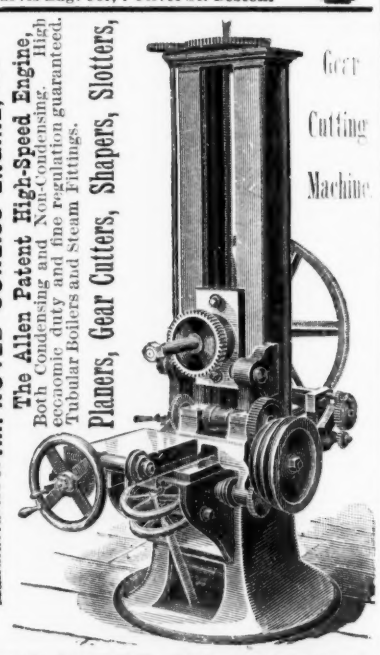

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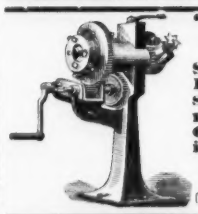

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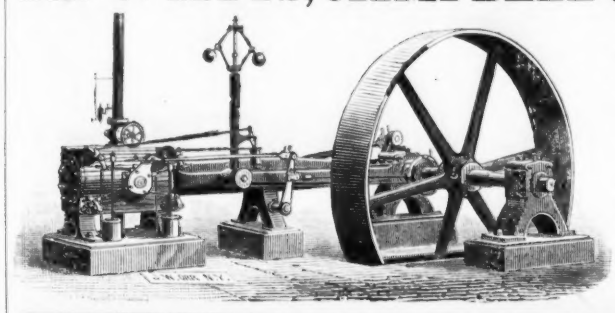

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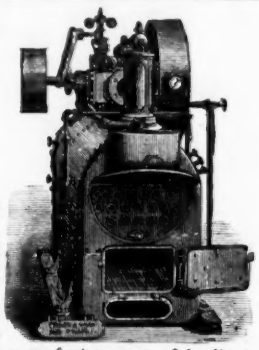

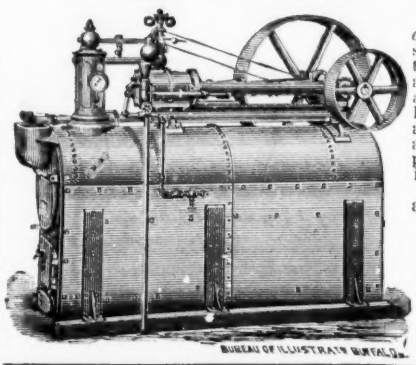

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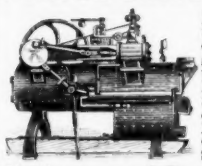

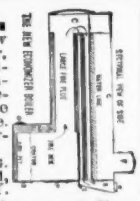

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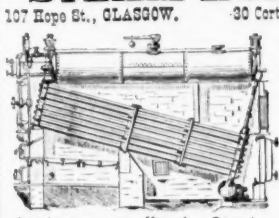

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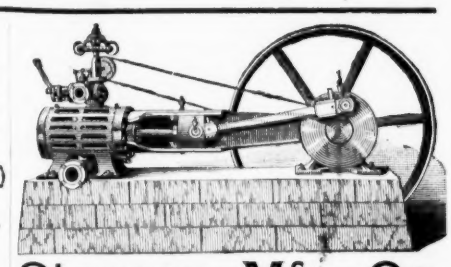

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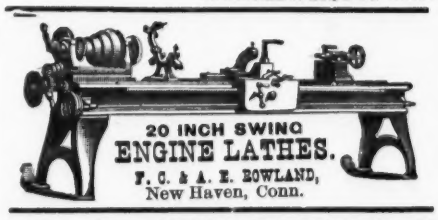

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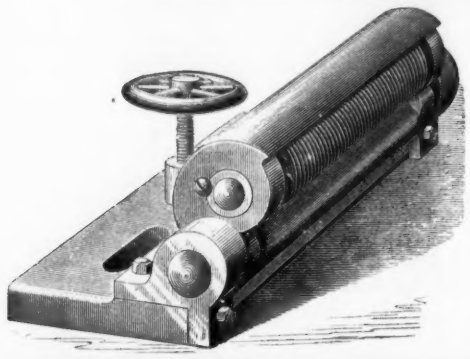

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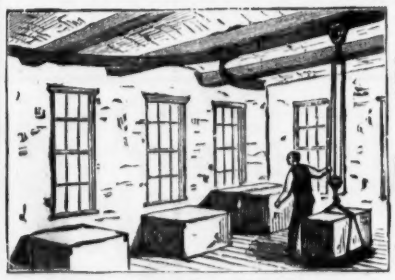

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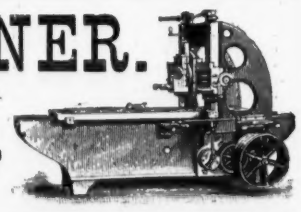

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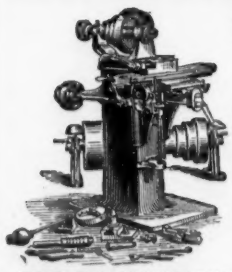

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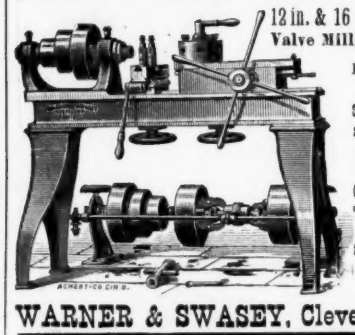

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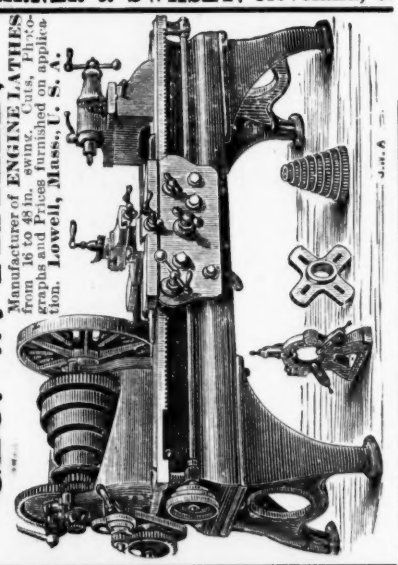

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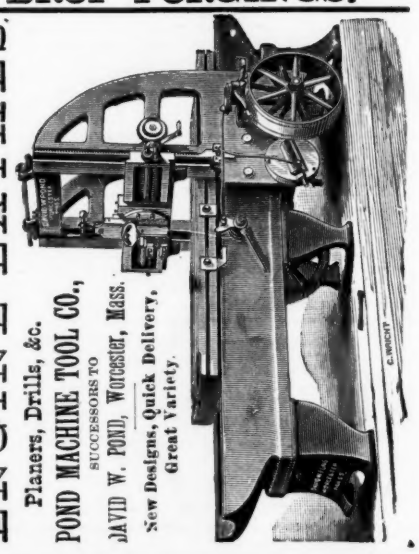

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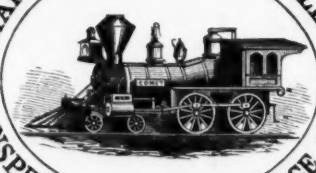

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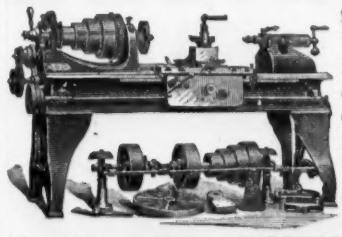

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